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TO ADVERTISERS

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Monday noon to insure publication in that week's issue.

It is very gratifying to every one interested in the future progress and development of electrical science and its applications to practical work to see the large amounts of money which are being offered by scientific and electrical societies for solutions of certain problems, or to those who make the greatest discoveries in any branch of electrical work. Large numbers of technical schools, in which the subject of electricity holds a foremost part, are springing up all over the world, and the time has come when men recognize the value of a thorough scientific and technical training to one who is to engage in any one of the numerous professions where it can possibly be helpful to him.

PRESIDENT McKINLEY.

The tragic death of Mr. McKinley comes as an inexpressible shock to the American people and is felt almost as a personal bereavement by all classes of citizens. Under his wise and tactful administration the country was wonderfully progressive and prosperous, and political differences had largely been forgotten. On all sides the administration was regarded as safe and patriotic, while confidence in existing conditions was widespread. The personal qualities of the President, his tact, modesty, simplicity and sound common sense made him universally popular and, by those privileged to know him, greatly beloved.

The blow aimed at the government by the fanatic assassin succeeded only in killing this honored and beloved citizen. The safe policies and conservative tendencies that marked his administration will be continued, and no fear is felt of any interruption of the conditions that have wrought so wonderfully of late for the betterment of this nation and all its constituent citizens. Mr. Roosevelt has already shown the same high qualities of administrative ability, sterling patriotism and energy, united with a stainless record in both his public and private capacities.

The national grief is embittered by the feeling that the tragedy at Buffalo might have been prevented by some more stringent laws for the suppression of the anarchistic spawn that has been so freely admitted to our hospitable shores. In this hour of mourning nothing is more certain than that this country will never again furnish an asylum to the murderous brood that is a common danger to all enlightened states.

THE HISTORY OF ILLUMINATION.

If the classical mythology could be reestablished in this engineering age it is hardly to be doubted that Prometheus would be made a divinity. In looking back over the general course of the human race it seems reasonable to fix upon the artificial production of fire as the greatest invention that has marked its career.

Fire meant not only heat and the arts of metallurgy and cookery, but it also gave practically an extension to the lifetime of each individual of the race by enabling him to work, to think, to talk and to meet his fellows during the dark hours that formed half of his life. In other words, artificial illumination gave a considerable extension to the lifetime of each individual and hence immensely accelerated the progress of the human race in general.

Perhaps the first artificial illuminant was the fire of brushwood and fallen sticks gathered by our remote and savage ancestors. Illumination by torches and burning logs continued to be practised until very recent historical times, although the invention of the lamp is one of the most ancient that the history of civilization has recorded. In the old Egyptian and Etruscan tombs lamps are found possessing all the essential qualities of the lamp of today, in having a reservoir for oil and a wick of some fibrous material. But the question of oil and the expense of its production greatly limited the use of lamps. Even as late as the fifteenth century we find public places and private houses still illuminated by the pine-wood torch or the roaring logs of the fireplace. One of the earliest decorative arts in connection with the household economy of our Saxon ancestors was the manufacture of iron sconces for attachment to the walls of rooms, these being intended to hold torches for furnishing illumination.

In classical times, in such centres of civilization as Rome and Athens, lamps

were in general use for interior illumination, but the streets were lighted, when this was necessary, by torches, each individual or group of persons who found occasion to go out during the dark hours carrying their own pitch-wood with them. It does not seem that fixed illumination of the streets was practised except on very special occasions; some of the streets of Rome, during the administration of the Cæsars, were lighted by flambeaux of burning wood, and the illumination of Nero's gardens is not likely to be forgotten—during this age, at least. At the entrance to the harbor of Alexandria the famous Pharos was built and in this a fire was maintained to light mariners through the harbor channels.

During the Middle Ages lamps of various kinds were in use, nearly all consuming some variety of vegetable oil, such as that made from the seeds of flax or the fruit of the olive tree. It was within quite recent times, historically speaking, that whale-oil was discovered to be a better illuminant than any that had been used before, and much of the early prosperity of the New England colonies was due to the whale-oil trade and the whale fisheries in the North Atlantic and neighboring seas.

In the early years of the last century illuminating gas was first manufactured in England, and in the larger cities of civilized countries piping systems were laid down for its distribution. The tremendous expense of such systems in those days naturally made it impossible to use gas for illuminating purposes outside of the large cities and regions where the area of distribution was small and the relative consumption large. It was during the early days of gas that a better illuminant than whale oil first came to be demanded —this largely on account of the increasing price of that fluid, due to the rapid extinction of the sperm whale in the Atlantic Ocean. A number of substitutes were invented, such as camphene, which was a product of turpentine distillation, and a variety of other oils manufactured by various chemical processes. About the middle of the last century came the discovery of petroleum in Pennsylvania, and founded on this grew the enormous industry of refining and marketing this oil for illuminating purposes.

Coincident with the general introduction of the petroleum products as illuminants, improved processes for the manufacture of pipes and various inventions of methods for manufacturing gas from coal greatly reduced the cost of gas distribution and made gas the principal illuminant in cities and towns of moderate size. By 1870 gas had come to be practically the recognized illuminant of civilized places throughout the world. The gas was made, either from wood or from bituminous coal, by a process of distillation, and subsequently purified, and chemical means for extracting valuable by-products from the residues of its distillation had so cheapened the price of manufacture that gas was well nigh ubiquitous. It was at this period that the electric light first appeared upon the scene.

As early as 1804—about the time that gas was first manufactured and used for public lighting—Sir Humphrey Davy discovered the electric arc. This brilliant phenomenon remained a laboratory experiment for nearly three-quarters of a century, waiting the time when large and powerful currents of electricity should be generated upon a commercial scale. Indeed, the first stimulus to the perfection of the dynamo came from a knowledge of the importance of the electric arc light, especially in connection with lighthouses. The Alliance machine, which was perfected in France in 1862, was used first for lighthouse illumination, and was shortly followed by the invention of the Gramme dynamo—one of the turning points in the history of electrical engineering.

The arc light was immediately recognized as the best illuminant for streets and large open spaces that had been devised and a host of inventors, on both sides of the Atlantic, applied themselves with great success to the perfection of arc light dynamos and lamps. At the time of the invention of the incandescent lamp—in 1884—the arc system was practically perfected and had attained a high commercial efficiency. The necessity, however, for an illuminant of smaller power and less concentrated energy than the arc had long been apparent and experiments covering a score of years had been made to devise a lamp which would permit what was then called the effective "subdivision of the electric current." This was thoroughly done by the introduction of the multiple system of connection using high-resistance incandescent lamps of small candle-power.

As in the history of the telephone, the greatest invention, doubtless, was the idea of the exchange, so in the history of the electric light perhaps the greatest invention is that of the central station from which energy in bulk is delivered over a considerable area for purposes of illumination. The story of the development of the central station, of the incandescent lamp and of methods of electric lighting in general is too recent and too familiar to need recounting here. It seems, however, as if we are again at a parting of the ways and as if new inventions of lamps are imminent. The arc lamp has been wonderfully improved in the last five years, and the incandescent lamp has steadily grown better since the day of its first manufacture. But even to-day the efficiency of both systems of lighting is very low, and the Nernst lamp and similar devices have given rise to a strong hope that we shall soon see an important betterment in this direction.

TROLLEY BAGGAGE CARS.

On many interurban and suburban trolley lines it is customary to operate baggage cars, and for the most part these cars are worked by separate motors and are operated as second sections of passenger trains. Whatever may be the reason for this practice it seems unnecessary, because in nearly all of such lines it would be perfectly possible to haul the baggage car behind the regular passenger car and thus save the services of at least the motorman ordinarily used in connection with it. Much the largest cost in railway operation of any kind is the labor account and it ought to be possible to reduce this in the way suggested in this important case. On several of such roads the small radius of curves prevents, however, the operation of more than one car to a train. The attention of railway managers whose properties

contain these curves is directed to the fact that the interest on the investment necessary for the ratification of such curves is generally considerably less than the increased operating expense that is imposed on the management by the necessity for single-car trains.

It is felt that the time has come to call attention to the elements of railway operation in connection with electric lines between cities and to suggest a number of important modifications that might be made in the working methods of such lines by closer attention to the science of railway operation which has been fully developed in connection with steam railroads. It is hoped in succeeding numbers of the ELECTRICAL REVIEW to call attention from time to time to various points in this connection which it is believed will be worth the investigation of street railway managers, especially those who have to do with long-distance lines running from town to town.

THE TUNNEL PROBLEM.

On other pages of this issue will be found a preliminary description of the work of the New York Rapid Transit Construction Company in constructing the subway which is to furnish some relief to the congested condition of the transit facilities of the American metropolis.

For twenty years or more the construction of an underground railway in New York city has been the subject of a continual discussion in the engineering and lay press. Half a dozen or more schemes have been devised, but the great engineering difficulties in the way of the successful construction of such a subway, combined with the naturally high cost of such an installation, have prevented any action being taken upon it until this late date. New York city is underlaid with rock of a gneissic variety, having no well-defined fracture and of an extraordinary hardness. This rock rises to the surface or near it in successive waves, the crests becoming lower at the south end of the island, and in some places the intervening valleys are filled with quicksands of the most formidable kind. All of these difficulties have added materially to the cost and trouble of construction and it is believed that when the rapid transit subway is finished it will be one of the most expensive pieces of railway construction in the world.

The most interesting problem in connection with the system, however, is one that it is not yet possible to throw any great light upon on account of the fact that the engineers in charge of the construction have not yet decided upon the traction system that shall be applied to the railway. Of course it is an understood and foregone conclusion that this system will be electrical, and it is practically understood that it will be a direct-current system, but its precise nature has not yet been determined and probably will not be for some time to come.

In the meantime it is known that it is the purpose of the construction company to provide for both local and express service in the tunnels and to use as high an acceleration as is possible in order that the overall schedule may be as fast as it can be made. The interesting details of the equipment decided upon are awaited with considerable expectancy by electrical engineers having to do with traction problems, but it is believed that a very fair forecast can be made of the system which will be adopted finally by those in charge.

It is thought that the multiple-unit system or some modification of it will most certainly be used, on account of the high acceleration which it is possible easily to attain with this system. Naturally, generation of current will be by means of alternators of the polyphase type, situated in a large power station convenient both to condensing water and coal delivery. This station will doubtless be constructed on one of the river fronts. Substations will contain apparatus for transformation and conversion to direct current, probably at a pressure not exceeding 700 volts. The car equipments, in the light of present knowledge of the subject, will probably be of the self-contained pattern adapted for multiple control, thus permitting an operation of trains of any number of cars that may be desirable. It is believed that an attempt will be made to attain very high overall speeds and to work the four tracks of the subway to the ultimate capacity from the beginning. It is hoped in later issues to give some account of the electrical equipment of this remarkable railway, but in the meantime this opportunity should not be allowed to pass without speaking a word of praise for the civil and mechanical engineers who have carried on the arduous undertaking now in hand. Probably no tunnel that was ever built has contained more difficulties than this one. That it has been constructed so far without serious interruption to street traffic and built in part through the most crowded streets in the world, is a testimonial to the high ability that has been shown by those having its construction in hand.

MILITARY TELEGRAPH LINES.

In the exceedingly interesting article by Lieutenant Sabin Gibbs, Jr., of the United States Volunteer Signal Corps, which appears on other pages, a glimpse is given of the conditions under which military telegraph lines are constructed and maintained in some of the difficult country in which our army has recently been engaged. One fact is evident from a perusal of this account and that is that in gallantry the Signal Corps is in no degree inferior to the man actively engaged on the firing line. The almost incredible difficulties under which the Philippine Islands field telegraphs were constructed and operated add brilliance to the achievement of this fine body of men.

When wireless telegraphy was first exploited it was believed that it would find a considerable use for the purposes of military signaling, but the event does not seem to have borne out this conclusion. Indeed, with ordinary lines operating telegraph and telephone apparatus as well as they do under such conditions as are described by Lieutenant Gibbs, there seems little need for wireless telegraphy, while it is believed that the difficulties of its proper operation in such country as he describes will be practically insuperable. There is still room for improvement in military telegraphs, and it is hoped that the subject will receive more attention than has been given it in the past.

Now that the summer is over, fan motors are standing idle all over the country. Is it not worth the while of central stations having many of these small breeze-makers connected to undertake the storage of their customers' motors for the winter and their overhauling against next summer's use? Such a course, a nominal sum being charged for the service, would insure satisfied customers next season.

Science Brevities

Braun Tubes as Electrometers — For studying the period of alternating currents Braun's cathode-ray tube has been used with much success. Mr. W. I. Milham has found it useful for measuring electrostatic fields, but in a somewhat indirect manner, for when the tube is placed between the electrodes there is no deflection of the cathode beam; when, however, the field is suddenly commutated, the fluorescent spot jumps aside, and then returns to its normal position, quickly at first, and then more slowly, says the *Electrician*. On repeating the commutation the throw is in the opposite direction, and the return is as before. The explanation is obvious. The field traverses the tube, but the cathode rays within the tube render the gas conducting, and the charges on the walls are thus neutralized. That this is the true explanation may be proved by interrupting the cathode rays during their returning motion by stopping the current. The luminous spot then disappears, and when the beam is restored the spot reappears, not in its normal position, but at the point it had reached when the rays were cut off. The speed of return is proportional to the throw, and the latter is proportional to the field. Under favorable conditions the author claims an accuracy to within one per cent for the measurements.

Effect of Gravity and Pressure on Electro-Motive Force—The anode is dissolved while the cathode is plated when an electric current is passed through an electrolytic cell. If the cell is made in the form of a tube, with the electrodes in the ends, the law of the conservation of energy would require a greater consumption of energy when the current passes up through the tube than when the tube is horizontal or when the current passes down. This greater consumption of energy will express itself as a difference in the electromotive force required for a given rate of deposit, and this difference may be regarded as a counter electro-motive force and detected as such. Some experiments in this direction have recently been made by Miss Rolla R. Ramsey, according to one of Mr. Fournier d'Albe's abstracts. Starting with the tube in horizontal position, the tube was turned to a vertical position and reversed repeatedly in unison with the galvanometer needle until a maximum deflection was obtained. Zinc or cadmium amalgams were used as electrodes, and the sulphates, either in solution or in paste, as electrolytes. The most consistent results were obtained with cadmium. The additional electro-motive force per centimetre height of a 10 per cent solution was found to be 4.78×10^{-8} volts, with a migration ratio of 0.02. The authoress also measured the effect of pressure and found that the electro-motive force increased in a linear manner with the pressure up to 300 atmospheres, and to a larger extent in a Clark cell than in a cadmium cell.

Metallic Conduction—Herr E. Riecke has attempted to solve the question whether or not metallic conduction is attended by a transport of metallic ions. The *Electrician* abstracts his results as follows: Such a transport of ions was suggested by the observed diffusion of metallic ions through solid metals, and was consistent with the author's electrothermal theory. The apparatus used by the author consisted of three equal cylinders, two of them being of copper and the third of aluminum. They were firmly pressed together, with the aluminum cylinder in the centre, and provided with copper leads. The apparatus was kept in the closed circuit of the battery of accumulators for a whole year, during which time it was traversed by about 958 ampere-hours. In an electrolytic cell this would have meant the deposition of 1.14 kilogrammes of copper. But on weighing the cylinders at the end of the year it was found that, with experimental errors, their weight had not altered. The author, therefore, answers the above question in the negative, and concludes that in metallic conduction no electric charges are conveyed by positive metallic ions.

New Method for the Measurement of Ionic Velocities in Aqueous Solutions—Mr. D. B. Steele gives a new method for the measurement of ionic velocities in aqueous solution, in the *Proceedings of the Chemical Society*. The liquid is enclosed between two partitions of gelatin, which contains the indicator ion in solution; on the passage of the current the cation and anion of the solution are followed respectively by those of the indicator. The indicator ions must move more slowly than the measured ions. The position of the boundary is easily seen on account of the difference of refraction; the motion is measured with a cathetometer.

Electrolytic Separation of Cobalt and Nickel—M. Balachowsky, in a communication reported in *Comptes Rendus*, has treated, in a platinum capsule, a solution in acetic acid containing, for every 0.3 gramme of Ni, three grammes of ammonium sulphocyanide, one gramme urea, 1 to 2 c.c. NH_4HO. The quantity upon which to operate must not be less than 100 c.c., the minimum current 0.8 ampere (ND_{100}), the voltage not to exceed one. The operation takes place at 70 or 80 degrees centigrade, and lasts about one and one-half hours, after which the nickel, containing all the sulphur present, is deposited upon the capsule. Should the electro-motive force be 1.2 volts, the deposit contains also CoS_2.

Quantitative Estimation of Copper in Pyrites—A quick and exact method for the quantitative estimation of copper in pyrites by precipitation with aluminum and electrolysis is given by C. N Heidenreich in *Zeitschrift für Analytische Chemie*. Two to five grammes pyrites are dissolved in aqua regia, the nitric acid evaporated off, and the residue redissolved in 5 c.c. dilute hydrochloric acid and 10 c.c. water. The whole is washed into an Erlenmeyer, diluted to 100 c.c. and warmed with excess of sheet aluminum on the sand bath. When the solution is colorless, showing that all the iron oxide is reduced, the solution is filtered, and the residue (copper and aluminum) is washed free from chlorine, the filter paper burned, and the copper and aluminum dissolved in nitric acid. The copper is then subjected to the ordinary electrolytic estimation.

Separation of Lead from Manganese—The following method for the separation of lead from manganese is given in the *Chem. Zeitung*, 1901, xxv, 393: A solution containing about 0.2 gramme of lead in 150 cc. and not more than 0.03 gramme of Mn, with 25 to 27 cc. of nitric acid of specific gravity 1.42, is electrolyzed at 70 degrees centigrade with a current of two amperes. The lead is completely precipitated as dioxide free from manganese in 35 to 40 minutes. With larger quantities of Mn, fairly accurate results are obtained by adding 35 cc. of nitric acid and a little oxalic acid to dissolve any precipitate of manganese dioxide, and using a current of two and one-half amperes.

Calcium Carbide—Metallic iron should be added to the mixture if the materials from which calcium carbide is made contain much silica. As a result, a ferro-silicon is formed in the electric furnace, and this, separating out on the top of the carbide, enables a comparatively pure yield of the latter to be obtained. The use of iron is the subject of a patent of Dr. Rathenau, of Berlin.

Selected Chapters in Electrochemistry.

By Harry C. Jones.

CHAPTER VII—CALCULATION OF THE ELECTRO-MOTIVE FORCE OF ELEMENTS.

PART I.

IN the six preceding chapters we have traced the development of the fundamental conceptions which underlie modern electrochemistry. In the first chapter we studied osmotic pressure, and showed how the relations between gas-pressure and osmotic pressure were discovered. The origin of the theory of electrolytic dissociation was traced in the second chapter, together with certain lines of evidence bearing upon it. In the third, certain applications of this theory were taken up. The fourth was devoted to electrolysis and the decomposition of electrolytes in general, by the current; the theories to account for electrolysis receiving special attention. Chapter five was devoted to the determination of the relative and absolute velocities of ions, and chapter six discussed the conductivity of electrolytes, and especially the application of the conductivity method to the measurement of electrolytic dissociation.

These chapters have, in a sense, been preliminary to the one which is to follow. We shall aim to show in this chapter how these fundamental conceptions have been applied to a problem of both scientific and technical importance—the calculation of the electromotive force of elements. This problem is interesting scientifically, because, for the first time, we are able to obtain any adequate conception of what takes place in a primary battery, and although such batteries have been known for more than a century, their action has been explained for only about a dozen years.

The problem is of technical interest because it enables the engineer to deal with primary cells in a theoretical manner, which is as simple mathematically as we ever hope such a problem to become.

We can, of course, assume that the methods of measuring the electromotive force of elements are familiar to all, and shall proceed at once to the application of the conceptions developed in these papers to the problem in hand.

It should be stated at the outset that the nature of the problem is not a simple one. The primary cell in its simplest form is a complicated device, involving a number of processes and operations; and the study of the action of these cells involves, necessarily, a number of conceptions which must be clearly grasped before the following deductions can be appreciated. Most of these conceptions have already been developed at sufficient length, but one or two additional features must be introduced in the proper places. Because a problem is a little complex, however, should be no barrier to its solution, but, on the contrary, should be an incentive to further effort. It is believed that the following solution will offer no serious difficulty to any one who has followed the preceding chapters, and who has even an elementary knowledge of the calculus.

CALCULATION OF THE ELECTROMOTIVE FORCE OF ELEMENTS FROM THE OSMOTIC PRESSURES OF THE SOLUTIONS AROUND THE ELECTRODES.

The first time that one comes upon this heading it is safe to predict that its meaning will not be fully understood. How is it possible to calculate the electromotive force of primary cells, from the osmotic pressure of the electrolytes around the poles? How could there be any close connection between osmotic pressure and the potential in a cell? are questions which are almost sure to be asked at the outset. Indeed, it is difficult to see off-hand that there is any connection between two sets of phenomena apparently so widely removed from one another.

A careful study of these phenomena will bring out the fact that there is a very close relation, indeed, between them; as so frequently manifests itself when we come to consider apparently disconnected phenomena in the light of some recently discovered generalization.

It should be stated at the outset that the very important deductions which are to be followed in this chapter we owe almost entirely to Nernst, who worked them out theoretically and verified many of them, while a privat-docent in the laboratory of Ostwald, in Leipzig.*

The fundamental principle which makes the following deduction possible is that if we allow a substance under one condition to pass into another condition, isothermally, it makes no difference how the transformation takes place; *i. e.*, whether we allow it to be accomplished osmotically by the flow of the solvent from one solution to another, or electrically, by the flow of a current and the consequent movement of the ions.

We must first find out the *maximum amount of external work* which can be obtained from a process, in which a substance passes isothermally from one condition over to another. This can be most readily accomplished by starting with a gas under one pressure, and allowing it to expand, isothermally, until it is under a considerably smaller pressure; since, as already stated in these papers, we know more about matter in the gaseous than in any other condition, and can deal with it far more freely.

Let us start with the gas under any pressure p_1 and volume v_1, then allow it to expand isothermally until it is under a considerably smaller pressure, which we will call p_2, to distinguish it from the first pressure which the gas exerted. When a gas expands thus, isothermally, it does work as we say, in overcoming the pressure of the atmosphere; or, to use technical terms, it takes up heat from the surrounding objects and converts it into energy of volume, which it can again give up. The amount of this is, from the well-known thermodynamic principle;

$$-\int_{p_1}^{p_2} v\,dp \qquad (1)$$

If we represent the pressure of a gas by p_1 and its volume by v_1, the combined expression of the laws of Boyle and Gay Lussac is; $pv = RT$, where R is the well-known gas constant and T the absolute temperature of the gas.

Substituting $pv = RT$ in equation (1) we have;

$$RT\int_{p_1}^{p_2} \frac{dp}{p} \qquad (2)$$

which expression for the volume energy obtainable from an expanding gas, can be readily integrated.

The integral is;

$$RT \ln \frac{p_1}{p_2} \qquad (3)$$

which is an expression of the amount of energy converted into work, which can be obtained from a gas which obeys the gas laws, expanding isothermally from any pressure p_1 to any other pressure p_2.

*For a fuller discussion of this whole subject, see Ostwald's Lehrbuch der Allgemeinen Chemie, Le Blanc's Elektrochemie, or Jones, Theory of Electrolytic Dissociation.

The question which arises here is what connection exists between the above deduction for a gas and the osmotic pressure of a solution? What has the one to do with the other? We will recall in this connection the contents of the first chapter, where it was shown that the osmotic pressure of solutions obeys the gas-laws, and we can see now one of the many applications of this highly important generalization.

Since the laws of gas-pressure apply to the osmotic pressure of solutions, we can apply any deduction from the one set of phenomena directly to the other set. The work obtainable from an ideal gas, in passing from a gas-pressure p_1 to a gas-pressure p_2 is, therefore, exactly equal to that which can be obtained for an ideal solution in passing from an osmotic pressure p_1 to an osmotic pressure p_2. In the above deduction the gas had a volume v, and passed isothermally from the one pressure over to the other. In order that the conditions should be comparable for the solution, it must also have a volume* v, and pass isothermally from the one pressure over to the other.

The all important point in the calculation of the electromotive force of elements from osmotic pressure, is the following: *The ions can not move in a solution without carrying with them the electrical charges which are upon them, and the amount of work obtainable from the ions in passing from one osmotic pressure to another, can be transformed into electrical energy.* This is the key to the whole deduction which follows. We have already seen how to calculate the work obtainable from an isothermal transformation of ions from one osmotic pressure to another. Since this work can be transformed into electrical energy, we can equate the maximum external work which is obtainable and the electrical energy which is equal to it.

We have thus far shown how to calculate the electrical energy obtainable from a solution whose ions are under an osmotic pressure p_1, in passing to an osmotic pressure p_2. But electrical energy is one thing, and potential or electromotive force is another thing. This brings us to the second important step, *what relation exists between electrical energy and potential?*

Electrical energy, like every other manifestation of energy, can be regarded as made up of two factors; the one expressing the quantity of energy and the other the intensity of the energy. In brief, we have a *capacity* and an *intensity* factor, and the product of these two is, of course, equal to the energy in question.

In the case of electrical energy the *intensity factor is the potential,* and the *capacity factor is the quantity of electricity.* The product of these two is equal to the electrical energy. If we represent the electrical energy by E_e, as is usually done, the quantity of electricity by E_0, and the potential by π, we have:

$$\pi \; E_0 = E_e$$

We know E_e, since it is equal to the maximum external work obtainable from the isothermal transformation discussed above, we know E_0 or the quantity of electricity carried by a given quantity of ions in passing from one osmotic pressure over to another; since from Faraday's law this is determined once for all for any given ion, and knowing the quantity for any given univalent ion, we obtain it for an ion of any valence by simply multiplying this quantity by the valence of the ion in question. From equation 4, we have:

$$\pi = \frac{E_e}{E_0}$$

"Let* us deal with a gram-molecular weight of univalent ions. These will carry 96,540 coulombs of electricity, and this quantity we will now designate by E_0. If the ions are bivalent they will carry twice as much; if trivalent three times as much, and so on. Let us represent the valence of the ions by v; then, a gram-molecular weight will carry $v\ E_0$ amount of electricity. Suppose a gram-molecular weight of these ions are charged π potential. The amount of electrical energy required to effect this charge is:

$$\pi\, v\, E_0.$$

But this electrical energy is equal to the osmotic, calculated above, where a gram-molecular weight was taken into account. We have:

$$\pi\, v\, E_0 = -\text{ RT ln } \frac{p_1}{p_2} \text{ or,}$$

$$\pi = -\frac{\text{RT ln } \frac{p^1}{p^2}}{v\, E_0} \qquad (5)$$

This is the fundamental equation for calculating the electromotive force of elements, from the osmotic pressures of the electrolytes around the electrodes."

Numerical values for a number of the quantities in the above equation are known, and can be readily inserted into it. Thus T, the absolute temperature of an ordinary room, can be taken as about 290 degrees (273 + 17). If we are dealing with gram-molecular weights of substances, R the gas-constant, is two calories, or near enough to it for all practical purposes; and one calorie is equal to $4.18 + 10^7$ ergs. E_0, the quantity of electricity carried by a gram-molecular weight of univalent ions, is 96,540 coulombs. We have, then:

$$\frac{RT}{E_0} = 0.0251 \text{ volt,}$$

since a volt multiplied by a coulomb is equal to 10^7 ergs.

Substituting this value in equation 5, we would have:

$$\pi = \frac{0\ 0251}{v} \ln \frac{p_1}{p_2} \qquad (6)$$

If we wish to pass from the natural to the Briggsian logarithm, we must divide by 0.4343, when the above expression becomes:

$$\pi = \frac{0\ 058}{v} \log \frac{p_1}{p_2} \qquad (7)$$

If we are dealing with univalent ions, $v = 1$, when we have:

$$\pi = 0.058 \log \frac{p_1}{p_2} \qquad (8)$$

This is the form in which we shall use the equation in all calculations of the electromotive force of elements.

This equation takes into account nothing but the osmotic pressures of the ions in the solutions around the electrodes. It contains no factor which says anything about the nature of the electrodes used, or of any relation between the electrodes and the electrolytes in which they are immersed. The story of the action of the cell, as thus far told, is very important, but it is not the whole story. It is self-evident from our knowledge of primary cells that the electrodes as well as the electrolytes must be taken into account, and we shall now see the way in which this is done. This second important deduction, like the one which we have just considered, we owe to Nernst, who was the first to explain the action of the primary cell.

THE SOLUTION-TENSION OF METALS.

The term solution-tension of metals is now so extensively used, that every one must have some conception as to what is meant by it. From this, the term solution-tension has extended to every substance which dissolves in any solvent, so that solution-tension has become coextensive with the term solution itself. While a general conception is held as to what is

* By volume of a solution is meant the number of litres which contain a gram-molecular weight of the electrolyte.

* This paragraph is quoted from Theory of Electrolytic Dissociation, by Jones, pp. 229-230.

meant by solution-tension, the exact use of the term must be understood before it can be used in connection with the electromotive force of elements. By solution-tension of metals we should understand that tension or strain analogous to a force, which tends to drive the atoms of metals off into the surrounding solvent. When the atoms are driven into solution, they are no longer present as atoms, but become ions. To illustrate, whenever a bar of metal is immersed in water, a few of the metallic atoms pass into the solution as ions; or, as we say, the metal dissolves to a slight extent. The number of metallic ions sent into the solution is very small in any case, and in most cases so small that they can not be detected by ordinary chemical methods, yet we have good theoretic ground for believing that every metal dissolves in every solvent to a slight extent—even platinum dissolves in water to an infinitesimal amount.

Nernst, who proposed this idea of the solution-tension of metals, driving the metallic ions into the solvent, suggested that it was analogous to the vapor-tension of liquids, which drives the liquid molecules into the space above the liquid, until, for a given temperature, a definite vapor pressure is reached. When this pressure is attained, the vapor-tension—still continuing to manifest itself—drives molecules into space, but the number of molecules which condense in a given time is just equal to the number which evaporates. This is the condition known as equilibrium.

The solution-tension acts in an analogous manner, driving ions into solution until a certain concentration is reached, when just as many ions separate from the solution on to the bar of metal, in a given time, as pass into solution. In the words of Nernst:* "If, in accordance with Van't Hoff's theory, we assume that the molecules of a substance in solution exist also under a definite pressure, we must ascribe to a dissolving substance in contact with a solvent, similarly, a power of expansion, for here also the molecules are driven into a space in which they exist under a certain pressure. It is evident that every substance will pass into solution, until the osmotic partial pressure of the molecules in the solution is equal to the solution-tension of the substance."

Nernst stated the whole subject of solution-tension of metals so clearly in his original, epoch-making paper, in which the contents of this chapter were discussed, that we can not do better than give his own words as literally as possible; since, from the importance of the subject dealt with, they have become of historical value:

"Let* us now consider what will take place if we dip a metal whose electrolytic solution-tension is P into a solution of one of its salts; the osmotic pressure of the metal ions in this solution being p. Let at first $P > p$; at the moment of contact a number of positively charged metallic ions, driven by this larger pressure, will pass into solution. Since by the latter a certain amount of positive electricity is carried from the metal into the solution, the liquid receives a positive charge, which arranges itself in the form of the positive ions contained in the solution, on the surface of the metal. At the same time there is, of course, a corresponding amount of negative electricity set free in the metal, which also passes to the surface of the metal. We recognize at once, that at the surface of contact of metal and electrolyte the two kinds of electricity must accumulate in the form of a double layer, whose existence, as is well known, was made probable some time ago by von Helmholtz, in an entirely different way.

"This double layer furnishes one component of force, which acts at right angles to the surface of contact of the metal and the electrolyte, and which tends to drive the metallic ions from the electrolyte on to the metal, and thus acts in opposition to the solution-tension. Equilibrium will be, of course, established when these two forces equalize one another. The final result will be the appearance of an electromotive force between the metal and the electrolyte, which will give rise to a galvanic current from the metal to the liquid, if by any device its existence is made possible.

"If $P < p$ the reverse of course takes place. Metallic ions separate from the electrolyte and are precipitated on to the metal, until the electrostatic component of force of the positive charge of the metal and the negative charge of the liquid, thus produced, are in equilibrium with the excess of osmotic pressure. An electromotive force again appears between the metal and the electrolyte, which, under suitable conditions, gives rise to a galvanic current, but in this case opposite in direction to the case first considered.

"If, finally, $P = p$, the metal and electrolyte are in equilibrium at the first moment of contact; therefore, no difference in potential exists between the two."

This clear and concise statement needs no comment and but little elaboration. If the solution-tension of the metal is greater than the osmotic pressure of the metallic ions in the solution, the action of the double layer is to oppose the greater pressure, which, in this case, is the solution-tension of the metal. If, on the other hand, the osmotic pressure of the metal ions in solution is greater than the solution-tension of the metal, a double layer is formed in such a sense as to oppose again the greater pressure, but in this case the greater pressure is the osmotic pressure.

In the first case the action of the double layer is, therefore, to drive metallic ions out of the solution on to the metal, in opposition to the solution-tension; in the second case the double layer tends to drive ions off from the metal into the solution, in opposition to the osmotic pressure of the ions already in solution.

The action of the double layer in both cases is to establish equilibrium between the solution-tension of the metal and the osmotic pressure of the metal ions in solution, and to do this it must, of course, always act against the greater force.

"If,* now, we inquire which metals have high and which low solution-tensions, we will find that magnesium, zinc, aluminum, cadmium, iron, cobalt, nickel, and the like are always negative when immersed in solutions of their own salts. This means that the solution-tension of the metal is always greater than the osmotic pressure of the metal ion, in any solution of their salts which can be prepared. If, on the other hand, we take gold, silver, mercury, copper, etc., we usually find the metal positive when immersed in a solution of its salt. This means that the solution-tension of the metal is so small that it is less than the osmotic pressure of the metallic ion in the solution. When a very dilute solution of salts of these metals is prepared, the osmotic pressure of the metallic ion may become less than the very slight solution-tension of these metals, and then the metal would be negative with respect to its solution."

A DEMONSTRATION OF THE SOLUTION-TENSION OF METALS.

One might easily think that this conception of the solution-tension of metals is all very well, as a matter of pure theory, and may, perhaps, help us in our explanation of the action of primary cells, but the most important question is, what

* *Ztschr. phys. Chem.*, iv, 150.

* *Ztschr. phys. Chem.*, iv, 151-152.

* Quoted from Theory of Electrolytic Dissociation, p. 235.

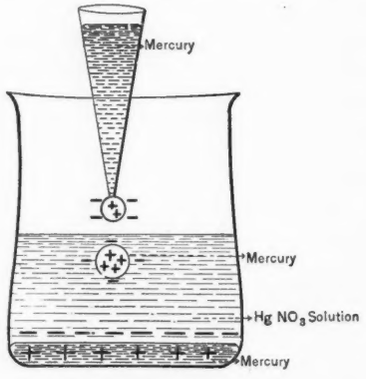
evidence have we that it is true? Indeed, there has been absolutely no evidence presented thus far; and does it not, after all, seem a little contradictory to our experience? If metals all dissolve in water and similar solvents, as this conception demands, why do they not dissolve in quantities sufficient to be detected by our most refined chemical methods.

This is a very natural state of mind for one to be in with respect to the whole problem, until the evidence for this view is presented and carefully considered.

With respect to the point raised above, that if metals like gold, platinum, silver, etc., dissolve in water, they dissolve in such small quantity that it can not be detected, it need only be recalled that the ions carry enormous quantities of electricity. A gram-molecular weight of univalent ions carries 96,540 coulombs, as we have already seen. The number of ions which would pass into solution in order to establish a considerable difference in potential between the metal and the solution, would be very small indeed. It has been calculated that the number required to produce the differences in potential which actually exist, would be far too small, in the cases of such metals as those named above, to be detected by the most refined methods known to man. This apparent discrepancy is, then, not at all at variance with the conception of the solution-tension of metals, but is exactly in accord with it, and could have been predicted beforehand with the greatest certainty.

It is, however, one thing to remove objections to a theory or conception, and it is quite a different matter to bring forward positive evidence of its truth. We shall now consider a demonstration of the solution-tension of metals, which seems to leave little to be desired. The following demonstration was furnished by Palmaer: Mercury* is a metal whose solution-tension is very small. Even when in contact with a very dilute solution of a mercury salt, the solution-tension of the mercury is less than the osmotic pressure of the mercury ions in the solution, and some of the mercury ions will separate from such a solution. Given a vessel whose bottom is covered with metallic mercury, and over this is placed a solution of mercurous nitrate, having a volume of 2,000; a few mercury ions will separate from the solution and give up their positive charges to the mercury. The positively charged mercury will attract, electrostatically, a few negative $\overline{NO}_3$ ions to form the double layer. This will be continued until a certain difference in potential has been reached, when equilibrium will be established. If, now, a drop of mercury is let fall into the solution, a few mercury ions will separate upon it, charge it positively, and it will then attract an equal number of negative $\overline{NO}_3$ ions, and drag them down with it through the solution. The next drop of mercury will behave in exactly the same manner, and thus the top of the solution will become continually poorer and poorer in salt.

When the drop of mercury comes in contact with the mercury at the bottom of the vessel, where equilibrium is already established, what will happen? When the drop has united with the mercury, this will contain an excess of positive electricity and, therefore, a small quantity of mercury ions will pass into solution; and, indeed, exactly the same number as there are $\overline{NO}_3$ ions carried down from the top to the bottom of the solution. The solution will thus become more concentrated just above the layer of mercury on the bottom of the vessel.



APPARATUS TO ILLUSTRATE SOLUTION-TENSION OF METALS.

A fine glass tube from which mercury flows is known as a drop-electrode. To produce changes in concentration sufficient for the purposes of a demonstration, a very powerful drop-electrode must be used. This is made by inserting a conical glass-stopper into a conical glass tube, so that the junction is mercury-tight. A large number of fine grooves are then etched on the outside of the stopper, so that the mercury will stream through as a fine mist. To assist this process the mercury is subjected to four or five atmospheres of pressure.

Under these conditions, however, the mercury can not be allowed to flow directly into a vessel filled with a dilute solution of a mercury salt, and containing mercury at the bottom, since there would be too much commotion in the solution. The arrangement which was used is shown in the accompanying sketch.

Here the mercury is allowed to flow directly into the solution, but the principle involved is exactly the same.

The drop-electrode T dips into the funnel-shaped vessel O, which is connected by a narrow tube and a rubber tube with the larger vessel M. This is in turn connected with the vessel U, where the change in concentration can be observed. When the mercury has been allowed to flow for five minutes under a pressure of five atmospheres, distinct changes in concentration can be detected.

Palmaer gives data which show that the *concentration above had been diminished as much as fifty per cent, and increased below as much as forty per cent.*

This will be recognized at once to be a very remarkable experiment, and before the conception of solution-tension of metals was proposed, would have been entirely inexplicable. It should be added that the results of this experiment were all predicted before the experiment was tried.

We have developed in the first section of this chapter the method of calculating potentials, or electromotive force, from the osmotic pressure of the solutions around the electrodes. Also the conception of the solution-tension of metals, and the way in which this acts when a metal is immersed in a solution of one of its salts. In the following section we shall apply these two fundamental conceptions to the electromotive force of primary cells.

Ztschr. phys. Chem., xxv, 266; xxviii, 257. Also *Ztschr. elek. Chem.*, vii, 287. The above description is quoted from Elements of Physical Chemistry by H. C. Jones, which will soon appear.

Electricity in Switzerland.

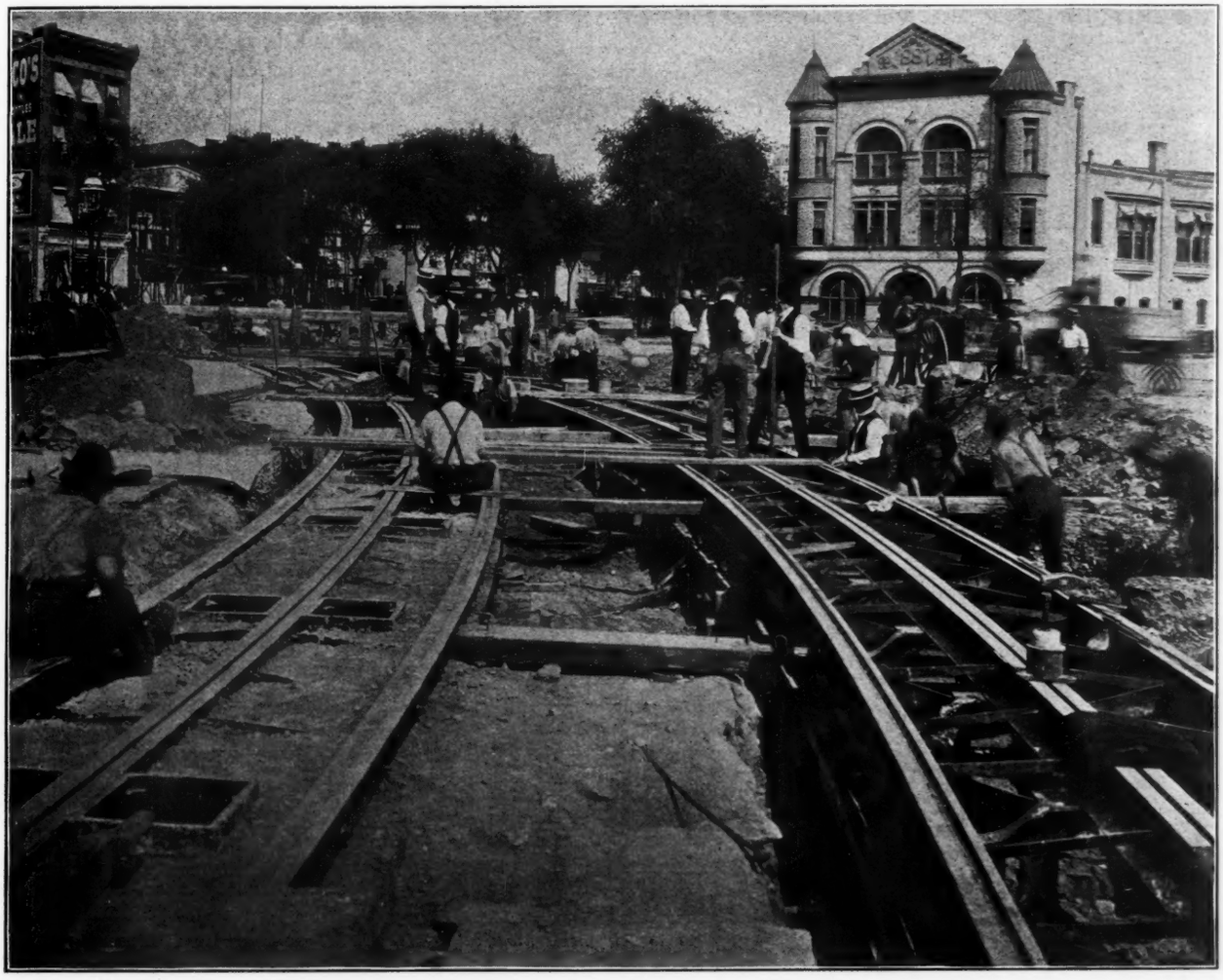
The Swiss town of Davos proposes to introduce electricity for all industrial and domestic purposes, thus dispensing with fuel of all descriptions, according to the London *Engineer*. An extensive electrical generating plant will be erected at the confluence of two mountain torrents, and it is stated that a prominent firm of Swiss electrical engineers has obtained the necessary permission to utilize the torrents for this purpose. The cost of the first installation is put at about $1,700,000.

Two prizes of $750 and $375 will be awarded by the principal electric railway company in Berlin for the best and second best speed indicator for electric cars. The conditions which such a device must fulfill are numerous. The maximum speeds are to be indicated to the motorman by means of visible or audible signals. The device must be also so simple and durable that the jarring of the car will not affect its operation. The competition closed on September 1.

The New York Rapid Transit Subway.

The New Underground Railway which is Being Constructed in New York City—Details of the Tunnel and Methods of Construction.

ON the morning of February 24, 1900, the contract for the construction of the Rapid Transit Railway was signed in the office of the Comptroller of the City of New York by President Alexander E. Orr, of the Rapid Transit Commission; Comptroller Coler and Contractor John B. McDonald.



THE "CIRCLE" AT FIFTY-NINTH STREET AND EIGHTH AVENUE—REPLACING SURFACE TRACKS.

With appropriate ceremonies the first excavation was made March 24, 1900, in front of the City Hall.

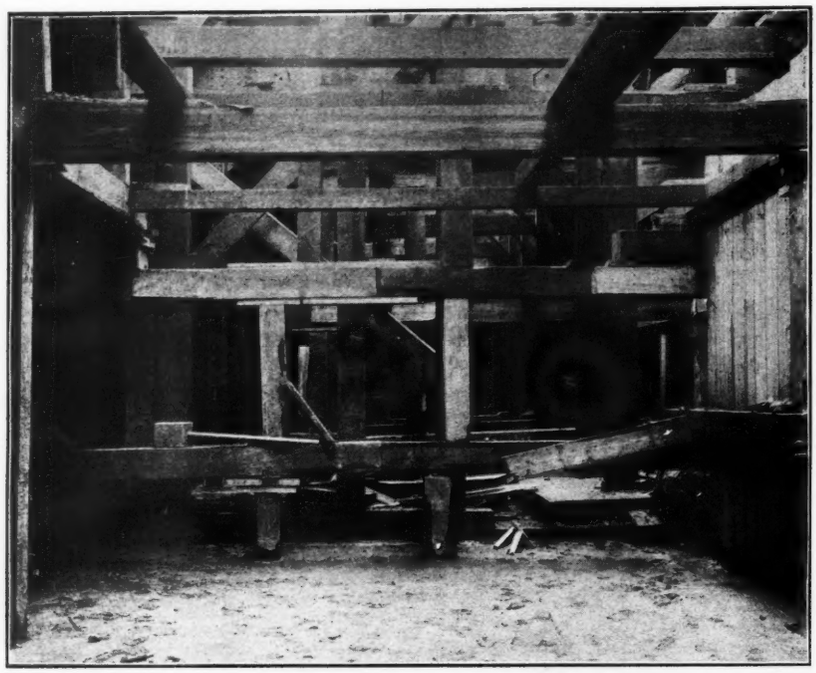
With this beginning was launched what is to be the most wonderful electric railway system ever conceived, and one over which, probably, more people will be transported in a day than any other of its length in the world.

The method of building this railway is different from that ordinarily pursued in building tunnel railways. Instead of an arched roof there is a rectangular structure, which is placed for the most part in an open trench. The surface of the street is being excavated to a depth of about 20 feet, and the tunnel is to be as near the surface as conditions will permit. At some places, however, it is to be from 100 to 150 feet deep, and in all cases where the track is more than 30 feet from the surface elevators are to be provided, but these places are very few in number. For the greater part of the way the passenger will scarcely realize that he is underground, since the roof for the most part is perfectly flat and the sun's rays are admitted wherever possible.

The main line of the tunnel will extend from the post office to Ninety-seventh street and will have four tracks. The two outside tracks are for local trains and the inner ones for express trains. It will be divided above Ninety-seventh street, and one branch, which is to be known as the West Side line, will extend to Spuyten Duyvil Creek, and another, the East Side line, to Bronx Park. Altogether the road is to be 20.6 miles in length, about seven miles of main line, seven miles on the West Side line and seven miles on the East Side line.

Around the general post office there is to be a two-track loop. The route of the main line follows Park row, Dewey avenue, Fourth and Park avenues, Forty-second street, Broadway to 169th street, West End avenue to Sherman's Creek, Ellwood avenue to Inwood street, and Broadway to 230th street.

There will be a sub-subway at 103d street on the east branch. Two tracks pass under



TENTH STREET AND FOURTH AVENUE, SHOWING HEAVY WOODEN SHORING NECESSARY TO SUPPORT TROLLEY TRACKS TEMPORARILY.

the north-bound track and continue under 104th street and Central Park to Lenox avenue at 110th street, up Lenox avenue to 141st street, under Harlem River, through private property and 149th street, Westchester avenue, Southern Boulevard and Boston road to Bronx Park. This section is called the Harlem River tunnel. It will be a double-cylindrical cast-iron tunnel, surrounded by concrete, one track in each section.

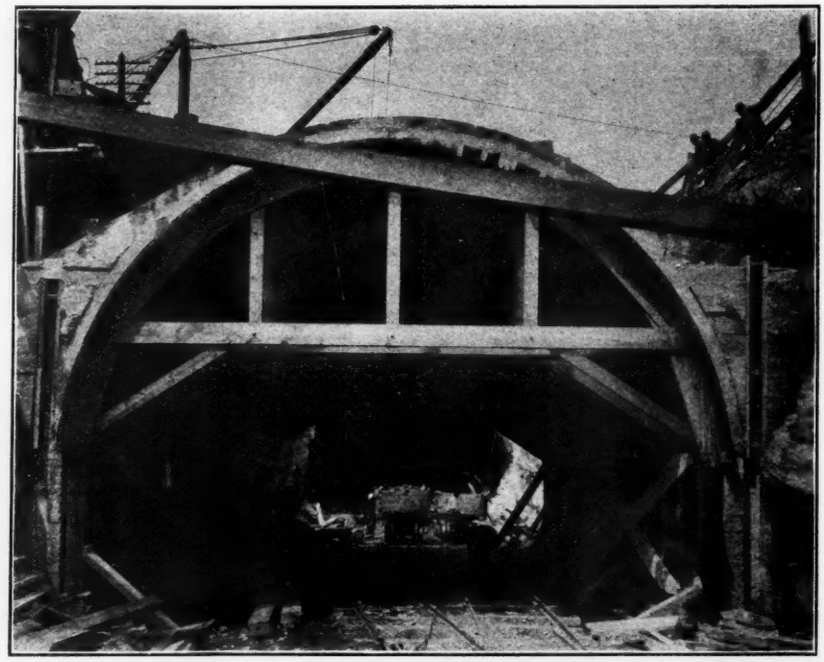
At Third avenue the road will emerge from the tunnel and run in an open cut on to a masonry viaduct approach to the elevated structure which begins at Brook avenue. This elevated road is to be much simpler in construction than any of the elevated roads now in use. Each column will be made of four bulb angles and a web plate. The trestle will be much lighter and more graceful in appearance than the present elevated structures. Plate girders 54 inches deep will support the tracks. This elevated section will run over Westchester avenue and Southern Boulevard and the Boston road to Bronx Park.

At Ninety-sixth street, on the West Side, the two outer tracks will run as close to the surface as possible, and continue up the Boulevard in a two-track steel and concrete construction to 122d street. It will there run out on a masonry approach to the Manhattan Valley viaduct, which begins at 125th street. The viaduct ends at 133d street, and the road runs underground through a masonry approach and open cut. The tunnel is entered again at 135th street. From 135th to 147th street the tunnel will be a standard two-track steel and concrete section. The two-track arched masonry section begins above 147th street and runs on a descending grade to Fort George at Eleventh avenue, where it emerges to the surface and the trains run on a short masonry approach to the steel viaduct at Hillside avenue and Ellwood street. The trains then run through Ellwood street on the viaduct to Broadway, or the Kingsbridge road, whence they run north and cross the ship canal to 230th street and Bailey avenue, just east of the New York Central Railroad station, where the road ends.

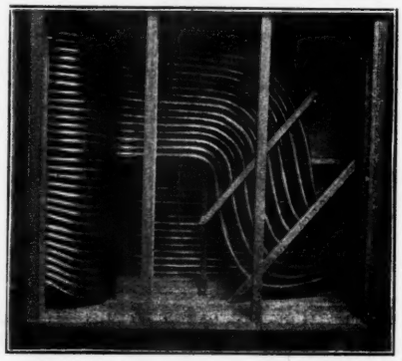
At the post office there will be a loop around which all trains will pass. It is so arranged that an extension can be built to the Battery at any time when it is considered advisable to construct it. In this event part of the trains could be run around the loop and part of them to the Battery.

The ties upon which the tracks will be laid will be steel T's, spaced six feet apart and imbedded in concrete. Channel irons are bolted to them, one on each side to act as guard rails. Timber blocks placed side by side are between them and under the running rail. These blocks are held in position by wooden timber on each side which are bolted between the guard rails. This arrangement is to prevent vibration and rumbling.

For the standard steel section the roof girders are 15-inch I-beams. In the side walls are placed 12-inch I-beams, while



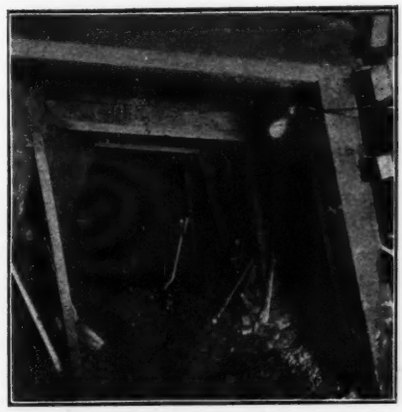
CONCRETE ARCH COMPLETED JUST SOUTH OF 158TH STREET.



MODEL OF ELECTRIC CABLE MANHOLE, BLEECKER STREET STATION.

the three columns between the four tracks are built up of bulb angles and the web plate. The outside dimensions of these columns are about six by eight inches. The columns are placed five feet apart. The size of the four-track tunnel will be 53 feet, outside measurement, while the two-track tunnel will measure 28 feet.

In all there are to be 48 stations. The underground stations will be entered from the sidewalks of the side streets, the entrance being covered with ornamental hoods. Separate staircases for entrance and exit will be provided. Concrete will be used in the construction of the platforms, which will be 200 feet long, 10 feet wide at the ends and 20 feet wide toward the centres. Electric lights placed in niches in the walls will be used in lighting the stations. These lights will be covered with opaque glass globes to give them the appearance of daylight. Wherever the station platforms come under a sidewalk the roofs will be made of glass, but the roofs of the other stations will be made of jack arches and concrete, and the ceilings paneled in wood and plaster.



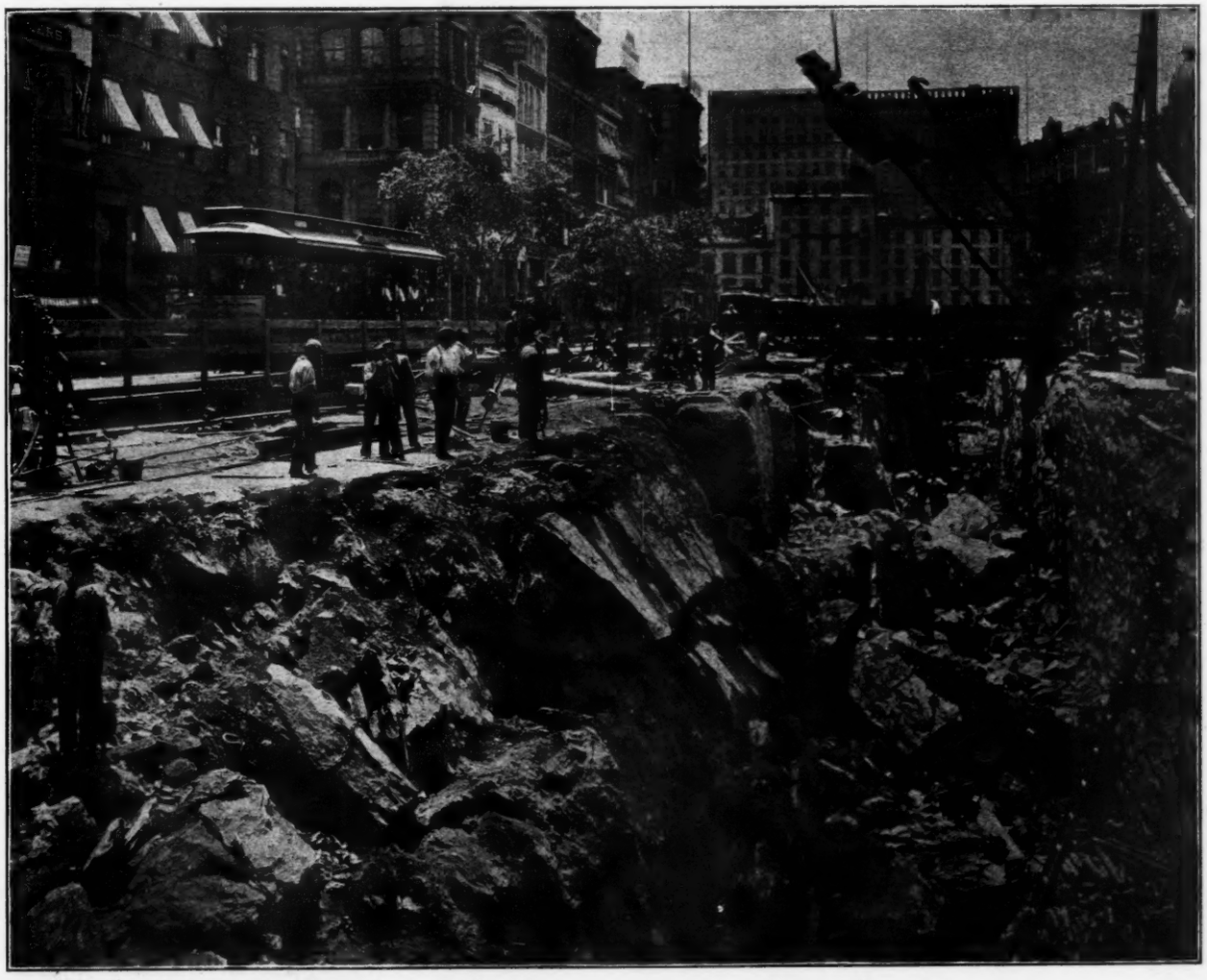
SIDE TUNNEL FOR DRAINAGE.

The first actual work upon the tunnel was begun at the corner of Greene and Bleecker streets on the morning of March 26, 1900. The Bleecker street sewer was lowered from Elm to Greene street, from 14 feet, its former level, to 21 feet, that it might pass under the tracks of the underground railway. The undertaking was marked by no special ceremonies. At eight o'clock Engineer William B. Parsons raised the pick and lowered it, the steel slipping in between the Belgian blocks and the great work had actually begun.

Mr. John B. McDonald took the contract to construct and equip the entire railway for $35,000,000. The construction work has been divided up into 15 subcontracts. These sub-contracts have been awarded to different contractors, and work upon them is now being pushed all along the lines. In all about 80,000,000 cubic feet of rock and earth are to be removed.

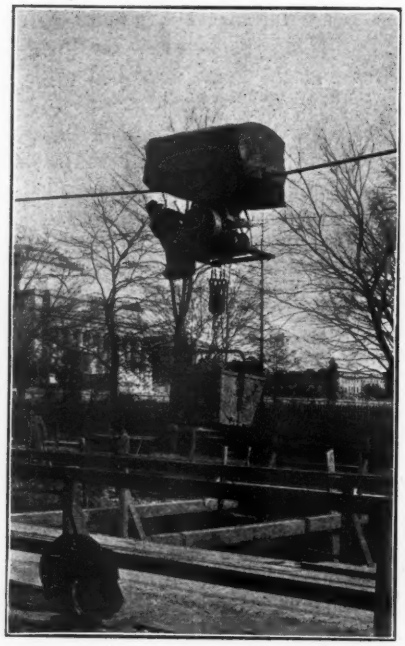
At the time the representative of the ELECTRICAL REVIEW went over the work, a few days ago, three shifts of men were being employed on some of the sections, and the work prosecuted both day and night, while in other places there were not more than one or two shifts.

Compressed-air drills are used in push-



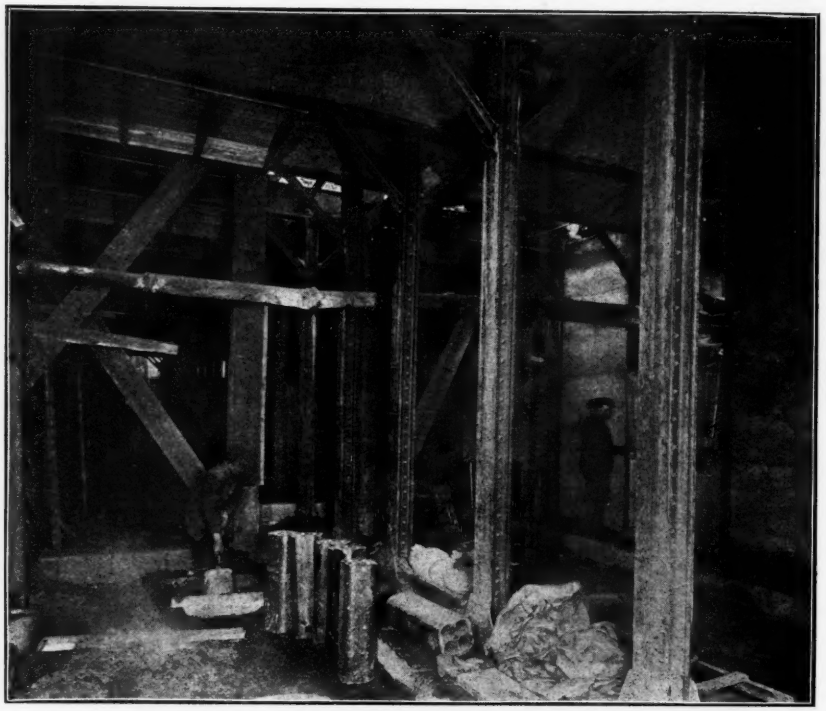
ROCK CUTTING, SEVENTEENTH STREET AND FOURTH AVENUE (UNION SQUARE).

ing the tunnel through the rock, three or four of which may be operated side by side on a single facing. The first step is



Electric Cableway Crab, Upper Broadway.

to drill three holes into the rock wall, forming a V-shaped incision. A blasting charge is then inserted and the three-cornered section marked by the drills blown out. Other holes are then driven straight into the rock in tiers of three or four, placed about two feet apart. These are then blown off until the full width of the tunnel has been removed. The pieces of rock removed are about two feet square. They are either lifted out by a steam derrick when they are near at hand, or hauled to where the derricks are in small cars, for which temporary tracks have been built.



Fourth Avenue and Tenth Street Completed, Showing Concrete Arches in Various Stages.

Completed Station at Sixtieth Street and Broadway.

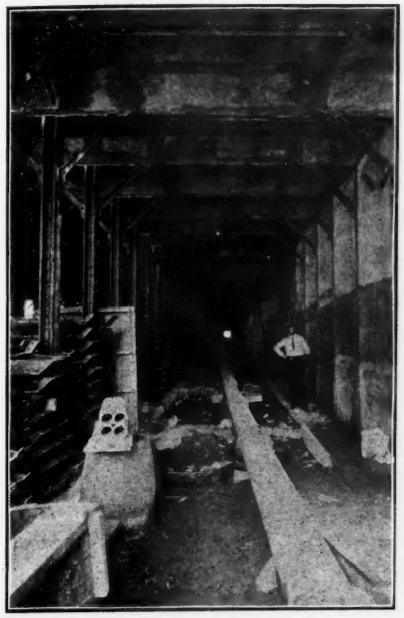
In the earth excavation skips are used. They are filled and lifted out by derricks, where the earth is dumped in wagons to be drawn away.

For the foundation at the bottom of the tunnel 12 inches of concrete are first laid down and four to six layers of felt, coated in hot asphalt, put over the concrete. This felt, coated with asphalt, is used to keep out the water. Six to ten inches of concrete are then laid over the felt. Substantially the same construction is carried out for the sides and roof of the tunnel.

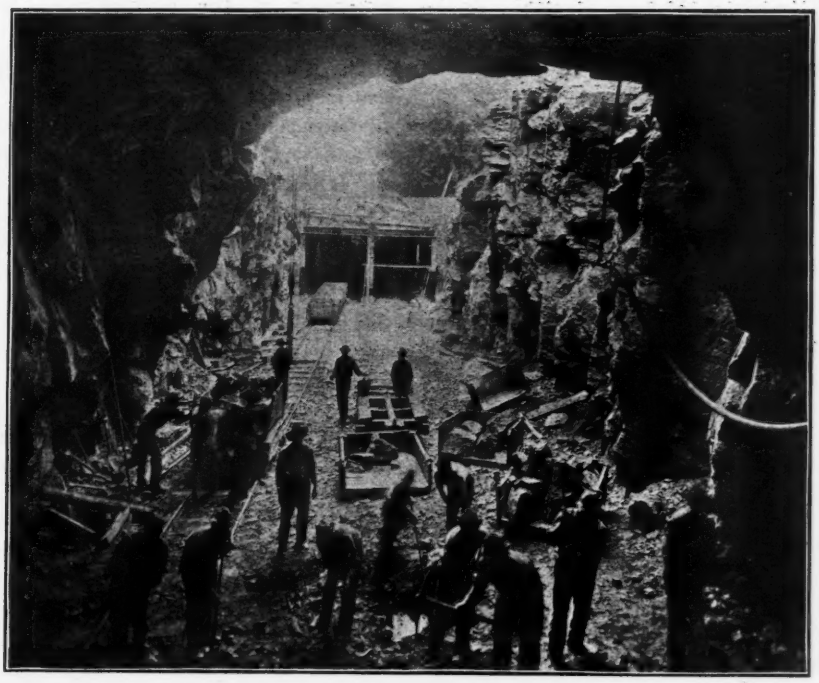
The side walls are formed of a series of arches from between columns of concrete 12 inches in thickness. Outside the side walls ducts are laid to carry the electric cables. Draining tiles are placed outside these ducts to provide for surface drainage connecting with the drainage system in the bottom of the tunnel.

In going over the work one can not but be impressed with the enormity of it and with the difficulties under which the contractors are compelled to work. In many places temporary road-beds for street cars have to be built that traffic may not be interrupted, while in many other places one-half the width of the street has to be opened at a time, and as the work is finished at one side of the excavation and the street restored, new work is begun at the other side. Thus only part of the steel framework and concrete can be finished at one time.

It is necessary to use an enormous amount of lumber for supports and props in many places to hold back the earth while the framework and the other parts



ELM STREET, SHOWING COMPLETED SECTION OF FIVE BLOCKS AND CONDUIT DUCTS IN PLACE.



LOOKING OUT OF CENTRAL PARK PORTAL TOWARD COMPLETED SECTION IN LENOX AVENUE

ELM STREET, SHOWING PIPE SUPPORTS AND DEPTH OF CUTTING.

of the tunnel can be constructed. As the openings are so large and so near together, there is very little suffering from heat even during the hottest days among those employed.

One very interesting piece of apparatus employed on a portion of this work is the electric cableway crab. This has been very fully described in the ELECTRICAL REVIEW of March 30, 1901, and is shown in the illustrations with this article. It is supported by one large cable. The motive power is furnished by electric motors to which current is supplied by a wire running parallel to the supporting cable. It is employed in conveying earth from the excavations to the wagons in which it is drawn away.

At the present time nearly one million dollars is being paid out each month for labor and materials used in the construction of the subway. In all about $8,000,000 has already been spent. As nearly as it is possible to estimate at present, about one-quarter of the work is completed; from the progress made it is expected that the work will be completed a year in advance of the contract requirements.

Mr. E. P. Bryan, the general manager of the company, has let the contracts for the engines and boilers, which amounted to $1,500,000. There are to be eight 5,500-horse-power stationary engines, which are to be supplied by the Allis-Chalmers company. The 48 boilers required will be furnished by the Babcock & Wilcox company.

Mr. Bryan expects in a few days to give out another contract of $1,500,000 for the electrical apparatus. It is stated that a polyphase system having transforming stations at convenient distances, with a third-rail, direct-current system of distribution, will be employed.

An electric traveling gangway is now being used between the cross Channel mail steamers at Dover and the shore. The apparatus consists of a platform on the endless-chain system worked by electric motors, and the unloading is accomplished at double the speed to what it was formerly, 15 seconds being about the average time for a package to travel from the boat to the shore at low tide, when the incline was at its steepest. Some of the packages weigh as much as 700 pounds.

Messrs. Pollak and Virág were invited by the French Government to make experiments with their new telegraphic apparatus over the lines between Paris and Lyons, when they displayed it at the Paris Exposition last year. The inventors, however, declined the invitation because of the enormous expense. They have established a line of their own extending from Budapest to Fiume, a distance of 375 miles, since that time, and a series of tests have been carried out with their apparatus. A speed as high as 40,000 words per hour has been obtained.

Extension of the Snoqualmie Falls Power Company's Installation.

The Snoqualmie Falls power installation is probably the most interesting of all water-power plants in existence. With a most varied service that includes electric traction, mill and factory power, as well as ordinary illumination, the entire load of the Snoqualmie system is operated in multiple and with a regulation of less than two per cent. The development of this installation is largely due to the business sagacity of the company's able president, Mr. Charles H. Baker.

Two years have passed since the first current from Snoqualmie Falls was carried into the cities of Seattle and Tacoma, Wash., and in this short time the initial installation has proven too small. The capacity of the plant is to be enlarged to meet the increasing demand for power in these growing western cities. At the falls, distant 44 miles in an air-line from Tacoma and 32 miles from Seattle, are installed in a rock-excavated chamber four generating units, each consisting of a water-wheel direct-connected to a 2,000-horse-power three-phase alternator. This famous power-transmission system now generating and distributing 8,000 electrical horse-power is to be more than doubled in capacity. At the same transmission voltage now employed, 30,000 volts, it is proposed to carry 12,000 horse-power more into the cities above mentioned, making a total output of 20,000 electrical horse-power. The electrical machinery is to be wholly furnished by the Westinghouse Electric and Manufacturing Company.

The Abner Doble Company, of San Francisco, which furnished the water-wheel equipment for the initial installation, is figuring upon placing wheels in the new extension, and an engineer of another water-wheel concern is likewise looking into the matter. The water-wheel contract will not be let for 60 days yet. If an impact wheel is used there will be a single wheel on each end of each generator shaft, and each wheel will be driven by a single jet of water 14 inches in diameter, the two jets combined being sufficient under the existing head of 270 feet to give the requisite power. The two water-wheels and the generator between will be built on a single hollow shaft of oil-tempered nickel steel.

The present underground generating station, which is 200 feet long, is to be lengthened out 150 feet up stream to make room for the new installation. A new penstock is to be built which will carry 50 per cent more water than the old one. The transmission line that is to parallel the old line will require 125 tons of aluminum wire, and the order for it has already been placed. At Tacoma a large and commodious brick and stone substation is now being erected. The entire cost of these improvements will be in the neighborhood of $400,000. The work is to be vigorously prosecuted, and it is expected that the first of the new generators will be delivering current into Seattle and Tacoma within the next nine months. The generating machinery will consist of three 3,000-kilowatt (4,000 horse-power) rotating-field generators of the two-bearing type, generating a three-phase current at 1,100 volts and 7,200 alternations. The speed is to be 100 revolutions per minute. Each generator will require an exciting current of 320 amperes, approximately, at 125 volts. For exciting these three generators a 200-kilowatt, eight-pole, direct-current generator of the two-bearing type is to be used. At 175 revolutions per minute it is to deliver under normal load a current of 1,600 amperes at 125 volts.

The current which is generated at 1,100 volts is to be raised to a line potential of 30,000 volts by nine 1,000-kilowatt, oil-insulated, water-cooled transformers. These are to be delta-connected on both the primary and secondary sides. It is estimated that each transformer will weigh 11,000 pounds and require 500 gallons of oil. The switchboard that is to be installed is to consist of 14 panels of white marble, and is to be of the special type that was furnished for the original installation. Instead of the Niagara-type single-phase indicating wattmeter that is in use on the present switchboard a polyphase, long-scale indicating wattmeter is to be used. Where formerly a field-plug switch was used a double-pole field switch is to be employed. The standard equipment of synchronizing lamps is to be replaced by a single pole-plug switch mounted on the generating panel and connected to a synchroscope which will be mounted on the multiplying panel. The increased capacity of the generators will necessitate placing three single-pole main switches instead of one three-pole main switch. The circuit-breakers, which are to be non-automatic, will be placed on an extension panel above the main instrument panel.

Electrolytic Permanganates.

M. Griner uses an anode of carbide, boride or silicide of manganese in a solution of caustic soda, 36 degrees Beaumé. A porous diaphragm separates the anode from the iron cathode. On passing a current through the cell sodium permanganate is formed in the anode chamber.

THE INDUCTION MOTOR AND THE ROTARY CONVERTER AND THEIR RELATION TO THE TRANSMISSION SYSTEM—I.*

BY CHARLES F. SCOTT.

Two important functions of an alternating-current transmission system are the production of mechanical power and the furnishing of direct current.

The induction motor and the rotary converter have become the usual means of transforming energy into these forms. The wide extent to which they are now used is a notable feature of recent electrical progress. An examination of their behavior in service, particularly in connection with other apparatus which might be used for the same purposes, will indicate the particular characteristics which have made them so successful. Occasion will be taken also to note some of the important interrelations between the various kinds of receiving apparatus and the transmission circuit and the generators by which they are supplied with current.

I—THE INDUCTION MOTOR.

Power may be produced by the synchronous motor or by the induction motor. A comparison between the two motors may be made by placing in parallel columns their respective characteristics in service, *i. e.*, those which concern the operation rather than the design. An induction motor with a secondary of the "squirrel-cage" type, started by applying a low electro-motive force to the primary, is taken for comparison—the description will require modification in some particulars if the secondary circuit is provided with adjustable resistance. These are of minor importance and do not affect the general comparison.

SYNCHRONOUS MOTOR.	INDUCTION MOTOR.
AUXILIARY APPARATUS.	
1. A starting motor; or, if self-starting, some form of resistance or transformer for reducing the voltage.	1. A two-way main switch with auto-transformers giving a low electro-motive force for starting. This may be located at any distance from motor.
2. An exciter, driven by the motor or otherwise, with circuits to switch-board and motor.	2. No exciter is required.
3. Rheostats for exciter and motor.	3. No field rheostats are required.
4. Instruments for indicating when field current is properly adjusted.	4. No instruments are required.
5. Main switch and exciter switches.	5. No exciter switches are required.
6. A friction clutch is required in many cases.	6. No friction clutch is required, as the motor starts its load.
CONSTRUCTION.	
1. Armature winding.	1. Primary winding.
2. Field winding with many turns. Liable to accident from "field discharge" if exciting current is suddenly broken; or from high electro-motive force by induction from the armature if the field circuit is open.	2. Secondary, short-circuited.
3. Collector rings and brushes.	
STARTING—NORMAL.	
1. Motor is brought up to speed without load; if starting motor is used, the main motor must be brought to proper speed and "synchronized"; if self-starting, the starting devices must be cut out of circuit at proper time.	1. Throw switch to starting and then to running position.
2. Exciter is made ready for delivering proper current and the motor field must be excited, adjustments being made by rheostats until instruments give proper indication.	
3. Load is thrown on by friction clutch or other means.	
STARTING—ABNORMAL.	
1 If the several operations in starting be performed improperly or in wrong order, injury may result. If a starting motor is used the synchronizing may be attempted at an improper speed or phase; if the motor is self-starting and it is connected to the circuit without the starting devices a large current will flow which may induce a high electro-motive force in the field circuit; if the field circuit be open a high electro-motive force may be induced in it at other times also.	1. The only possible error is in starting with the switch in the running or full voltage position, which simply causes the motor to exert a greater torque and consume a greater current than is necessary.
2. If a load having inertia be applied by closing the friction clutch too quickly the motor may be overloaded and stopped.	2. The motor starts its load and requires no friction clutch.
3. If motor stops owing to failure of current supply, it is not self-starting when the current returns. An attendant is always required for starting.	3. The motor will stop if the current is cut off at the power-house and then start again when the current is supplied to the circuit.
STARTING AND MAXIMUM RUNNING TORQUE.	
1. The starting torque of the self-starting motor is very small and an excessive current is required for developing it. The motor starts as an introduction motor, but inefficiently, as the design which is best for synchronous running is not good for starting.	1. The starting torque is adjustable and may be several times full load torque.
2. The maximum torque, is several times the full load torque, and occurs at synchronous speed: below this speed the torque is very small; any condition which momentarily lowers the speed causes the motor to stop.	2. The maximum torque is usually greater than that of the synchronous motor, but it occurs at a reduced speed and there is a large torque at lower speeds.
SPEED.	
1. The motor has a single definite speed; at other speeds its torque is very small and the current is very large.	1. The motor may be designed for a practically constant speed, with large torque at lower speeds; or for several definite speeds by changing the number of poles; or for variable speed work, such as is required for cranes, elevators, hoists and the like.
CURRENT.	
1. If there is useful starting torque the current required for producing it is very great.	1. The starting current may be made proportional to the torque, and is one and one-half to two and one-half times that required for the same torque at high speed.

* Paper read before the American Institute of Electrical Engineers, August 22, 1901.

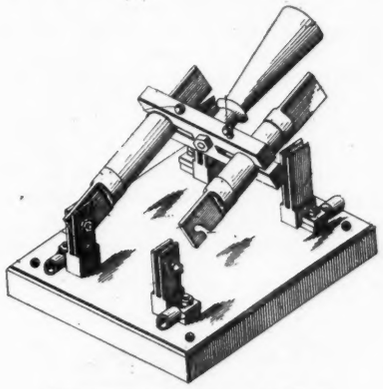
	CURRENT.	
2. The running current depends upon the wave form. If the wave form of the motor and of the circuit differs, a corrective current will follow, which can not be eliminated by adjustment of field excitation.	2. The running current is practically independent of the difference in wave form, as it has no wave form of its own.	
3. The running current depends upon uniformity of alternations of the current, *i. e.*, upon the uniformity of the speed of the generator and other synchronous motors. The motors attempt to follow the generator speed exactly. If the latter pulsates, the motors pulsate also; they vibrate about a mean position, "hunting" or "pumping." One motor pumping incites others. The current is increased even though the conditions may still be operative.	3. The current is practically independent of fluctuations in generator speed, as there is a slip between the synchronous and the actual speed of the motor.	
4. The running current depends upon the relation between the field current (which is adjusted by the attendant) and the electro-motive force of the circuit. The main current may be made leading or lagging or theoretically it may be neither. The electro-motive force of the circuit is an element which is under the partial control of the attendants at every motor as well as at the generator station.	4. The current is not subject to any adjustments which the motor attendant can make, nor is the electro-motive force of the circuit in any way under his control.	
	POWER FACTOR.	
1. As the power factor is the relation between actual current and energy current, it is dependent upon wave form hunting and field current. Under favorable conditions the motor may have a high power factor; under many actual conditions it may not; under some conditions the highest attainable power factor is less than that of the induction motor.	1. The power factor varies with load, but is definite and is practically independent of wave form and hunting.	
2. The current may be lagging or leading, depending upon the motor field strength.	2. The current to the motor is always a lagging current.	
	REACTION UPON GENERATOR AND CIRCUIT.	
1. The motor impresses its own wave form on the circuit.	1. The motor has no wave form to impress upon the circuit; its tendency is to smooth out irregularities in a wave which is not a sine wave.	
2. A motor may augment the fluctuations in generator speed by the oscillation of its own armature. One motor may increase the disturbance in the circuit so as to interfere with other motors which would not have been seriously affected.	2. The motor has a damping action upon fluctuations in frequency; in some cases a synchronous motor which hunts may run smoothly when an induction motor is connected to the same circuit.	
3. As the current may be either lagging or leading, the drop in the electro-motive force in the generator and between generator and motor may be either more or less than that which could be caused by a non-inductive load or by an induction motor.	3. The drop in electro-motive force is always greater than would be caused by non-inductive load.	
4. If a short circuit occurs in the transmission system the motor acts as a generator, which thereby greatly increases the current and the intensity of the short circuit.	4. The motor does not generate current when there is a short circuit.	
5. If the circuit is opened, either by a switch, a circuit-breaker, a fuse or the breaking of the line, the motor speed falls, its electro-motive force is no longer in phase with that of the circuit; the two are thereby added, thus doubling the normal electro-motive force and bringing increased strains on the insulation and the opening devices.	5. The motor does not generate electro-motive force when it is disconnected from the circuit.	
	CAUSES WHICH MAY ACCIDENTALLY STOP A MOTOR.	
1. Momentary lowering of electro-motive force caused by short circuit on the line, or by accident at another motor, or by error in synchronizing a generator, or by the "switching over" of the motor from one circuit to another, is apt to cause the motor, particularly if carrying load, to fall from synchronism and come to rest.	1. Momentary lowering of electro-motive force causes momentary decrease in speed.	
2. A heavy load, even momentary, may exceed the limiting torque and cause the motor to drop from synchronism, even though the load be removed immediately. The connection between generator and motor is rigid.	2. An excessive load receives the stored energy of the motor and of the load itself as the motor falls; when the excess load is removed the motor speed increases again. The connection between generator and motor is elastic.	
3. If the generator speed suddenly increases, a motor carrying a load having inertia may be unable to increase its speed quickly without exceeding the limiting torque, which will cause the motor to stop.	3. The motor readily follows changes in generator speed.	

Experiments with Automobile Tires.

M. I. Chelin has lately conducted a series of experiments in France with different kinds of pneumatic tires for electric cabs. The conclusion to be drawn from the results of these tests apparently is that there is a considerable saving of electrical energy together with a gain of speed in the use of pneumatic tires for electric automobiles. In the first place an electric cab was run a distance of about two miles on a hard, smooth road with ordinary wheels at an average speed of 13.94 feet per second, and the electrical energy consumed in the journey amounted to 1,037,680 watt-seconds. The same cab, with four pneumatic tires, performed the same journey on the same day and at the same speed with a consumption of 817,840 watt-seconds. In a somewhat similar trial the use of pneumatics led to a saving of 17.9 per cent in energy and a gain of 5.3 per cent in speed.

Electrical Patents

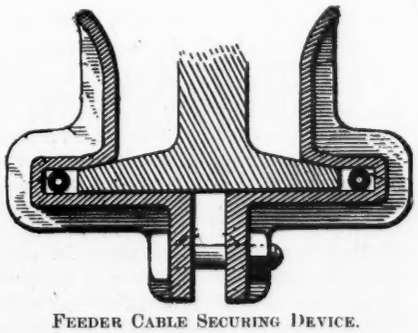
Mr. George E. Linton, of Worcester, Mass., has devised an improvement in electric switches. The improvement resides in the construction whereby the switch also serves as a fuse-block, so that when the fuse is blown it is only necessary to open the switch, insert a new fuse



COMBINATION SWITCH AND FUSE.

and again close the circuit. The blades of his switch are in the form of separate boxings, pivotally mounted at one end in the usual manner, and connected contiguous to their other ends by an insulated cross-bar which carries the usual handle. These blades or boxings are detachably secured to the cross-bar, and each comprises tubular insulated casings, to the ends of which are detachably fastened the metallic contact pieces. The fuse wire connects these pieces, and it will thus be seen that when the fuse is blown it is only necessary to detach one of the blades and either insert another having the necessary fuse wires or replace the blown fuse.

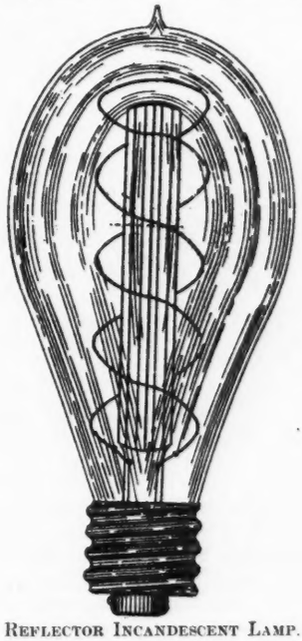
A novel device for securing feeder cables to the third rail of an electric system has been patented by Mr. Walter D.



FEEDER CABLE SECURING DEVICE.

Young, a resident of Baltimore, Md. The device is in the form of a pair of hooks arranged to be slipped over the opposite base flanges of the rail, each being provided with a pendent ear, through which cars is passed a bolt that holds the clamps in position upon the rail. The hooks are of peculiar construction, having upstanding guard pieces forming guides into which the cable is slipped. The sockets of the hooks into which the flange of the rail is received have their outer portions tapered, while the inner portions are contracted to form sockets for the reception of the wires.

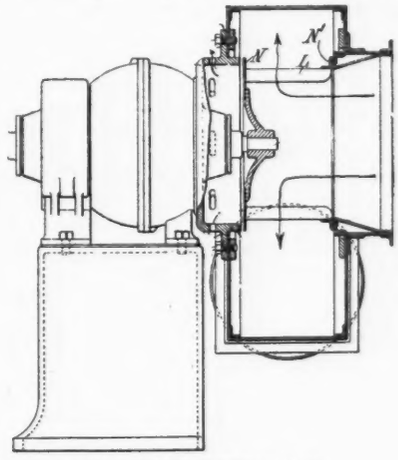
A new incandescent lamp that the inventor claims has many advantages has passed the inspection of the Patent Office, and is now ready for the public's verdict. The bulb, with its connections, is constructed in the ordinary manner, the invention residing in a reflector located within the bulb and having on its exterior surface a series of longitudinal corrugations or prisms. This reflector is hollow



REFLECTOR INCANDESCENT LAMP.

and has a smooth inner face coated with the reflecting material. The filament entirely surrounds it. The rays of light from the incandescent filament are thrown outwardly with practically no loss of radiant power, and are thoroughly diffused over a large area. In fact, the inventor, who is Mr. P. A. Gibbins, a resident of New York city, states that a lamp constructed in accordance with his ideas has the appearance of a luminous bulb, and that the incandescent filament can not be discerned.

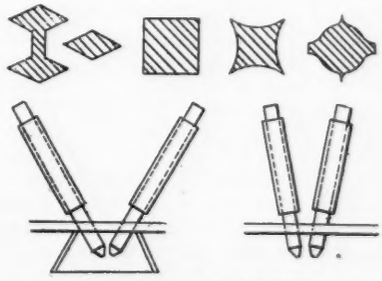
A decided improvement has been made in the construction of centrifugal fans operated by electric motors. In this type of fans it is common to couple the fan directly to the motor, and to fix the casing directly to the motor shell. As is well known, this is usually done by a connecting casing which, however, is air-tight. The objection to this construction is that in operation the fan tends to either drive or suck the oil from the motor bearings, due to back pressure or exhaust, according to the kind of a fan employed. The present invention avoids this disadvantage by providing ventilating passages between the space enclosed by the connecting casing and the outer air, these



NOVEL CENTRIFUGAL FAN.

passages preferably passing through this connecting casing. As a result, the pressure within the same is maintained at approximately normal atmospheric pressure, and no influence is brought upon the bearings. The inventor of this improvement is Mr. Samuel C. Davidson, of Belfast, Ireland.

Herr Hugo Bremmer, residing at Neheim, Germany, has obtained a patent in the United States on a new form of arc light, in which he does away with the lower vertical carbon that so greatly interferes with the emission of the light. Instead, he provides two pairs of carbons, one pair being positive and the other negative, the negative pair, however, not being underneath, but by the side of the positive pair with the points slanting downward.

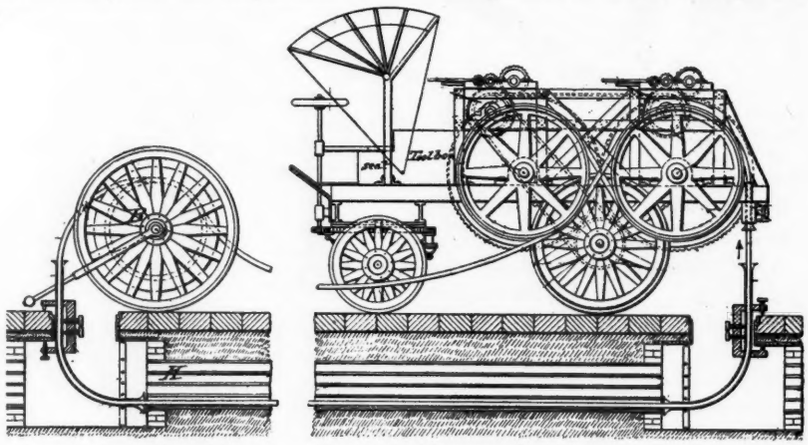


NEW TYPE OF ARC LIGHT.

Both pairs of carbons are arranged obliquely toward each other, and the electrodes of each pair are likewise arranged in oblique relation, so that all the carbons diverge from each other at their lower ends. The luminous arc is thus formed at the lower end of the lamp, and there is

nothing in the way to prevent the radiation of light in all directions. A metal chamber surrounds the carbon points and forms a reflector above the arc. The carbons are made in short sections, a number of these sections being located in a magazine and automatically fed down so that as fast as one is burned out another will take its place. The carbons are, furthermore, made in a novel manner and of a new composition, this being the subject matter of another patent. By reference to the following extract from the patent specification, it will be seen that he lays claim to the fact that his new electrodes yield much more light than the ordinary ones now made: "This invention refers to electrodes for arc lamps, consisting of a mixture of pure carbon or carbon powder and metallic salts. The extra yield of light thus obtained is not confined to the application of a few materials, but, on the contrary, a large number of metals, or salts of metals or metalloids—for instance, calcium, magnesia, megnesium, strontium, glass, fluorspar or mixtures thereof—will form vapors which are brought to a state of brilliant incandescence by the heat generated by the combustion of the carbon pencils. The extra yield of light will increase with the percentage of the addition of above mentioned substances, while the tendency to flickering of the luminous arc will be reduced by the application of a somewhat high percentage. Disturbing influences standing in the way of the application of metallic salts are constituted, first, by the scorified secretions formed by the metallic salts, and, secondly, by the circumstance that if the percentage of metallic salts is excessively increased, the percentage of carbon being reduced accordingly, the heating effect produced by the combustion of the carbon is greatly reduced, so that the metallic vapors are not completely brought to incandescence. The scorified secretions, however, are chiefly formed at the margin of the carbon pencils in those parts where they are not vaporized by the heat of the small intensely luminous points from which the luminous arc issues. They will sooner or later form an incombustible coating, which will eventually smother the luminous arc. Now the principle on which the present invention is based consists, essentially, in causing the otherwise solid scoria which is formed by the luminous metallic vapors under the influence of the electric arc to be softened or liquefied by a so-called 'flux,' thus causing them to drip off periodically. Such fluxes are formed, for instance, by boron and fluorine. If a sufficient quantity of such substances is suitably added to the respective salts of metals or metalloids in a proportion of not less than one per cent of the total weight, or more, according to the height of percentage of the addition of metalloids, as mentioned above, which make the arc very luminous compared with the arc of the ordinary carbons, it will be found that the secretions, instead of forming a hard granular scoria, will assume a soft liquid character and can be still further influenced and caused to drip off with as little disadvantage as possible by any one of the arrangements to be described hereinafter. In preparing the electrodes, care should be taken to prevent the carbon pencils (which, under ordinary circumstances, are generally calculated to generate the highest possible degree of heat during their combustion) from being heated to such a degree as to cause the fluxes, which, in most instances, will be vaporized at a comparatively inferior temperature, to be expelled prematurely from the carbon pencil. An electrode thus impregnated with metallic salts, etc., by mixing the carbon powder with the additions and burning them in the known manner, may be treated so as to cause the light to assume any desired tint. Thus, for instance, I have found that a yellowish tint is best imparted to the light of the luminous arc by adding to the composition some fluorine, bromine or iodine. Fluorine, in particular, if added with the carbon compound in conjunction with more than twice its quantity of calcium or calcium salts, will yield a light of a pleasant yellowish tint which, if desired, may be made more of a whitish tinge by adding some magnesia. The easiest way to add the fluorine and boron is to bring it in connection with other metal salts, as cryolite or fluor calcium, or to mix the pure carbon with fluor carbonite. In each case the fluor conjunctions are thoroughly mixed with the carbon compound. The means adopted in order to remove the drops of liquefied scoria formed on such an electrode without interfering with the light will be seen from the figures shown in the annexed drawings. On the ordinary round carbon pencils the scoria will collect in the form of little clots at the lower extremity, and the latter being tapered these clots will frequently glide down toward the incandescent point, when they will interfere considerably with the light, both while it is burning and at the time of relighting. This evil is remedied by providing the carbon pencil with ribs. In this case the drops of scoria will have a tendency to collect at the ribs, and will then drip off straight downward, so that the luminous arc will continue to burn uninterruptedly in the centre of the pencil end. If desired, notches or grooves, placed transversely to these ribs, may also be made on the carbon pencils. It will be seen that if the carbon pencil is further consumed, the rib, together with the drops of scoria adhering to it, must drop off with absolute certainty. If only two such ribs are provided, these will not in any way impair the emission of light, because these ribs may be placed in the same plane with the conducting rods of the lower pencil holders, and as on the whole the formation of the long arc is much impeded by a great area of emission. Consequently, any carbon pencil shaped so as to have sharp edges, if impregnated with a high percentage of salts of metals or metalloids, will afford these advantages, because even with an inferior strength of the electric current an area free from any scoria will always remain in the centre, thus insuring steady burning, while the scoria will always accumulate at the sharp edges and drip off from these at intervals."

And now we are to have a machine for hauling electric cables through underground conduits and the like. The inventor of this machine is Mr. Henry B. Grinnell, of New York, N. Y., and his idea seems to be entirely practical. The mechanism is to be mounted upon an ordinary wheeled wagon frame, and can be run by an engine or hand-power as desired, the power being also employed for propelling the vehicle much on the order of a traction engine. A couple of driven shafts are mounted across the vehicle frame and carry at their opposite ends sheave pulleys over which the hauling ropes are run. A series of gear wheels are connected with these shafts, and the power applied through the same. In the preferred construction this is shown as manual, and handle cranks are therefore provided, these cranks being detachable and so arranged that they may be secured to different sized gear wheels according to the power necessary for operating the sheaves. In order to properly direct the cable and hauling rope operated upon by the machine, guide tubes are secured by clamps to the manholes through which the cable and rope are passed, these tubes being curved and having upright upper ends and horizontal lower ends which may be arranged at the mouths of the conduit duct through which the cable is passed.



Machine for Drawing Cables into Conduits.

FIELD TELEGRAPH LINES.*

BY LIEUTENANT SABIN GIBBS, JR.,
SIGNAL OFFICER, U. S. V.

Among the untold number of inventions that have been brought forth in the last few years, great numbers have been theoretically applied to the use of warfare. They comprise methods of accomplishing labor of all kinds with greater efficiency as to rapidity and volume of work handled, for the most part improving the results that were at one time reached by crude and unskillful means. In addition to this, there have been made possible many feats, which seem simple enough now, that were useless to attempt by the limited means of a few years back. As is the result of trial of all things yet untried, some have proven to be vastly overestimated; the difficulties involved in the use of others have outweighed the value of the good obtained, while the best that can be said of many is that they have exceeded all expectations and created a new sphere of usefulness. Two wars, the Boer-English and the Spanish-American, including the Philippine insurrection which grew out of it, have given excellent opportunities for testing the real merits of many of these products of modern scientific invention, and it is the intention in this work to include in its scope the observations and deductions concerning the application of electricity to modern warfare that three years' campaign with the army in the Philippines has furnished.

Such uses of the electric current as the firing of large guns electrically, and the sighting of them by the use of electric motors, and the operation of searchlights for signaling and illumination are worthy of mention, but by far the most general and most valuable applications of electricity are those of transmitting intelligence by means of the telegraph and telephone. At the beginning of the recent war with Spain it was the common, if not universal, opinion that the signal flag, torch and heliograph would play an important part in maintaining communication between the various parties making up an army in the field, and consequently the men of the Signal Corps were rigorously trained in the use of the Meyer code. Even the signal officers themselves, to whom this duty is intrusted, did not anticipate how completely these instruments would be superseded by the telephone and telegraph. This fact has not come about through any decrease in efficiency of the former, and it can only be said that their disuse is due to the infinitely more effective and practical applications of electrical transmission, which have been more phenomenal than their most enthusiastic promoter could have expected. I will venture to say that few people, even in the army itself, realize the extent of the business now being handled by the United States military telegraph system. The figures for the month of October, 1900, were as follows:

Manila Central Office, sent and received..... 23,906
Luzon system, sent and received 260,735

Even these figures do not tell you that many single messages would fill two of these printed pages. They range in importance from orders from the commanding general concerning the movements of troops to invitations to dinner.

Commissary, medical, quartermaster and ordnance stores are ordered from the bases of supply by telegraph, and the principal function of the mail in handling official business is to carry certain printed forms and signatures required by the service, long after the real business has been transacted over the wire.

Naturally, the first form of electrical communication to be used in warfare is the field line which connects the various bodies of troops with their headquarters and with each other. Other lines of this class are carried with moving columns which constitute expeditions against the enemy at a distance from the military base.

A typical system of field connections, perhaps, was the one used with the army operating against the city of Manila, in August, 1898. On top of the tall shears on the dock at Cavité was placed a flag station, which communicated with all of the war vessels and army transports lying at anchor in the harbor. In an adjacent building a telegraph station was installed, from which ran a line around Manila Bay to Camp Dewey, a distance of about 20 miles. For this line No. 14 galvanized iron wire was used, it being put up partly on pine lances, partly on trees, and for some distance on the poles of the old Spanish line which was at that time being used by the insurgent forces. Pony insu-

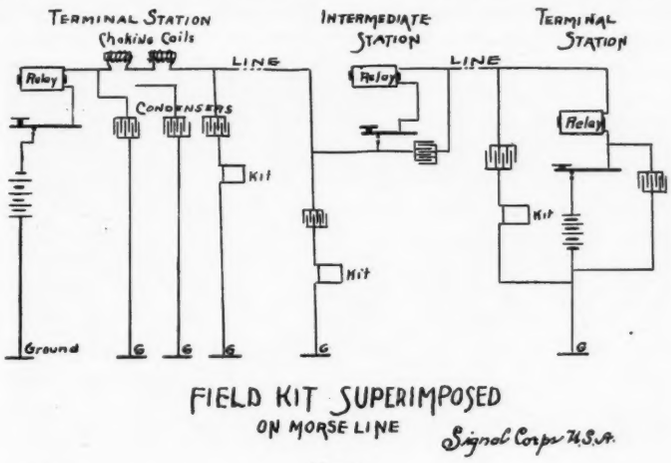


FIG. 1.

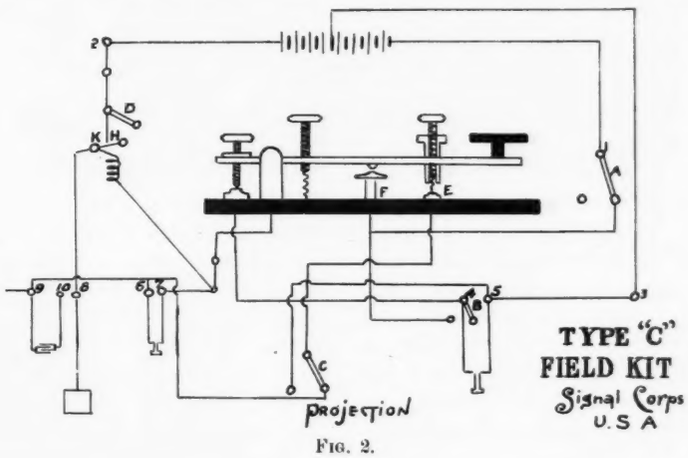


FIG. 2.

* From *The Transit*, journal of the Engineering Society of the State University of Iowa.

lators on ordinary light brackets insulated the line, and at the terminal stations, which were semi-permanent, Morse sets, consisting of relay, sounder and key, were used. The battery was made up of gravity cells placed 12 in a box, and carefully packed to withstand rough handling in transportation.

The line of American trenches was about a mile nearer Manila than Camp Dewey, and to connect the various positions a separate line was built as follows: From either end of a single battery and set, at the Camp Dewey station, two insulated No. 14 copper wires were run toward and within half a mile of the trenches. Here they separated and ran to the extreme flanks of the trenches, where offices were cut in. A similar wire was laid on the ground back of the trenches connecting these offices, and also including an office midway between the two. Leaving Camp Dewey the wires were raised on bamboo poles high enough to be out of the way of marching troops, but as they approached the trenches they ran along the ground, being less exposed to damage from shell fire. Thus it will be seen that all of these stations were connected by an endless metallic circuit, or without the use of a ground. However, batteries were placed in the line at the two flank stations, as well as the Camp Dewey station, so that in case both lines were shot away there would still be communication between all the stations along the line of intrenchments. This arrangement was carried into effect immediately after the first line, which was a single one, was carried away by a Spanish shell on the night of August 5.

When the American troops advanced from the trenches on August 13, the line to the left flank was detached from the triangular circuit and continued on up the shore of the bay into the city of Manila. A "ground" in place of the detached line left the remaining sides in working condition.

For the stations on this line, box relays were used, which, although difficult to hear under heavy fire, were convenient on account of being compact and easy to carry. This instrument is essentially similar to the ordinary Morse relay, but has coils covered by a square box fastened to the baseboard. Holes are cut in the box opposite the ends of the cores of the relays, and opposite the front contact point of the armature lever. At the other end of the box are the screws for adjusting the magnet, and a Morse key is fastened to the right side of the baseboard. The coils are usually wound to have a resistance of 75 ohms. The method of adjustment is exactly the same as that employed with the ordinary Morse relay. As the armature lever is made as heavy as possible, that, with the box acting as a resonator, increases the sound sufficiently to do away with the local battery and sounder, although these may be connected with the special binding-posts provided for that purpose.

Under favorable conditions of weather, such a line as the one described has been found to work very satisfactorily, but during the time that this line was in operation the downpour of rain scarcely had an hour's intermission in days. The dense tropical foliage bent down under the weight of water, and in many places carried with it the telegraph line, poles and all. The broad leaves of the banana and nipa palm enveloped the wire with their wet surfaces, and sapped from it the feeble current that was trying to carry the messages to direct the movements of thousands of troops, and the supply of their rations and ammunition. The theoretical resistance of the line per mile could be easily determined, but when the theoretical amount of battery to work the line properly was applied it was found wanting, and all theory gave way to the demands of practical necessity, and the number of cells required was determined by experiment. Linemen patrolled the lines day and night to improve the insulation, but in the limited time it was impossible to put the line in safe condition. At times the leakage became so great that no business could be handled by means of the Morse instruments. These results occurred, of course, on the bare wire, as the insulated wire was taped at the joints and, for the time being, impervious to climatic conditions.

The vibrator, or "buzzer," as it is usually called by the men of the Signal Corps, is an instrument constructed for the purpose of working through lines that can no longer be worked by the Morse system. The first form of this instrument was invented by Major Cardew, of the English Army, in 1881, and the various types now in use in the United States service depart but slightly from the original pattern. Some convenient arrangements have been added by way of improvement, and the accompanying illustrations show type "C," which has proven to be the most efficient instrument of this kind. The *field-kit,* as it is also called, consists of a stout wooden box, about a nine-inch cube, which opens into two nearly equal parts.

One side contains the battery of eight dry cells. The other side contains an electromagnet with an armature mounted upon a spring, and a back-contact stop; the coils, armature and stop, forming, with the key, a local circuit for the battery. When the circuit is completed by the key the armature is attracted, breaking the battery circuit, thus allowing the armature to fly back and reestablish the circuit. The armature, which is a steel spring, is short and very rigid, and the vibrations produced are so rapid that a musical note is made, and the ordinary current from the battery is transformed into a pulsating one, which is originated by the charge and discharge of the coils. The adjustment is very delicate, and, as shown in Fig. 1, the instrument is provided with an adjustment screw attached to the spring armature, and to further facilitate and maintain the adjustment, the contact point is mounted upon a spiral spring, and this in turn upon an adjustment screw. The telephone receiver is placed in the line, because by means of it the operator can tell that the signals are going out of the line and that the adjustment is correct. The buzz of the unaided armature itself is not loud enough to be

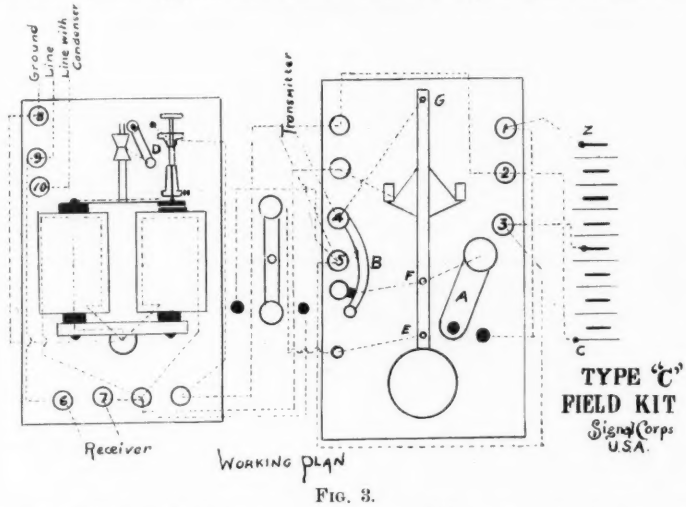


FIG. 3.

heard while sending. The accompanying illustration, Fig. 2, showing a projection of the connections, will indicate, perhaps more clearly, the method of the connections and the relations of the switches, A, B, C and D, to the parts they affect. It will be seen that the battery is divided so that the transmitter uses but four cells.

FIG. 4.—LANDING THE SIGNAL CORPS CABLE AT CORREGIDOR ISLAND.

When the full battery is used, the grating or rasping sound produced impairs the efficiency of the instrument. The switch D short-circuits the coils, thereby producing, instead of a musical note, the regular Morse click, which works well enough over short distances, but the succession of rapid pulsations will actuate the instrument at a considerable distance more clearly. A condenser is placed below the base of the instrument, and is inserted in the line by using the binding-post for that purpose, as shown in the illustration, Fig. 3. It has the effect to increase the intensity of the charge or discharge of the coils, and proportionately extend the range of usefulness of the instrument.

FIG. 6.—FIELD TELEGRAPH STATION IN NIPA SHACK.

The receiver is usually of the head type, and is worn by the operator during the entire time that he is on duty. It has been found that the addition of a second receiver allowing the operator to have one to each ear, is a great help when the signals come faintly.

The intermittent current produced by this instrument penetrates seemingly impossible conditions of line, working through a barb wire actually down in the mud, and on several occasions has been known to work satisfactorily over breaks where the separate ends were lying on the ground as much as two feet from each other. Thus in the case of the field heretofore described, as in a great many instances since, messages were gotten through on a line that was incapable of being worked with Morse instruments.

FIG. 5.—TESTING SUBMARINE CABLE, SHOWING CABLE BOX ARRANGEMENTS.

No estimate can be made of the value of successful communication by this means. The use of the "buzzer" always becomes necessary just at a time when the messages are of the most vital importance. The general in the field in these later days has come to depend greatly upon the telegraph to control the movement of troops at a distance, and its failure would render concerted action uncertain, and the rapid handling of troops impossible.

The most remarkable example of the efficiency of the type "C" field-kit that comes to mind is as follows:

Early in December, 1899, a cavalry expedition was made from Bocaue, a station on the Manila & Dagupan Railroad, to Norzagory, a town some 15 miles distant; a signal officer was given orders to keep the column in telegraphic communication with Manila. Just at that time there was no insulated wire available, in fact, the only wire to be had was some heavy No. 9 galvanized iron wire, and the idea of following a rapidly moving column with such material seemed impossible. It was undertaken, however, and the line party laid a No. 9 bare iron wire, weighing about 330 pounds to the mile, along the trail behind the troops and kept up with the same. No attempt was made toward insulation, except to see that the wires were placed along the edge of the trail where the ground was bare of grass, and to hang it on the fences where it ran through villages. Field-kits were installed at the terminals, and for more than 10 days during which the line was used, not a single message was delayed. This remarkable success was due to the fact that December is in the dry season, for in the early morning when the entire line was wet with a heavy dew, the signals could be read very faintly indeed, and during the one shower that fell they were drowned out entirely, but were restored soon after by the sun rapidly drying the ground.

Since that time moving columns have sometimes been followed by a No. 20 bare copper wire, put up on insulators when time permitted, but for the most part hung on the bushes which line the sides of the roads and trails. This method has been used where the distance was too great, and the transportation too limited to permit carrying the heavy insulated wire. The copper wire was wound on reels in one mile lengths and weighed but three pounds per 1,000 feet, but had the disadvantage of being easily broken. Its small size made it difficult to see, and consequently our own troops did not have a fair chance of observing and avoiding the line. Spans have been driven into by escort wagons and broken without the driver knowing it, where if a wire of greater breaking strain were used the obstacle would have made its presence known and the line preserved. Although the value of the two classes of line just described should not be underestimated, they serve to show, mainly, what may be accomplished when the most desirable materials are not obtainable and how extremely valuable a makeshift may become. In one instance when wire was not to be had in any other way, the copper wire making up the armor on two miles of river cable was unwound, thereby giving about 40 miles of light copper wire.

TRANSPORTATION.

It has been the great improvement in materials, rather than in the methods of carrying materials and constructing lines, that has made it possible to keep rapidly moving columns of troops in telegraphic communication. In the practical work of the Signal Corps, there has been a notable absence of any departure from the old-time methods of stringing wires. Usually, the original coils of insulated wire for field use have been loaded on transport wagons, bull-carts, or on the backs of coolies, and from these supplied to an ordinary Western Union reel. The reel has been mounted across the top of a wagon box when the course lay through country that could be traversed by wagon. In other cases the reel has been carried on the backs of four natives or Chinese coolies. In one instance a cart was built, very similar to a two-wheeled hose-cart, with a reel that contained about four miles of insulated wire. The wheels were but three feet apart, which permitted the cart to be taken along narrow trails, and its compact solid construction enabled it to be taken wherever a mule could go, or wherever men could climb. A friction brake on the reel prevented its running away while paying out, and handles, which extended radially from the end-plates at either end of the reel, furnished the means of taking up the wire. The use of more such carts at a time when they would have been of the greatest service was impossible because there were no materials at hand for their construction. Had they been already in use, it is believed that the problem of carrying insulated wire into the mountains where the ordinary wheeled transportation is abandoned would have been solved. On accompanying General Hall's expedition to Antipolo in June, 1899, fifteen miles of insulated wire, weighing about two tons, were carried by 45 Chinese coolies over a trail that was inaccessible except to men in single file. A short bamboo pole was passed through two coils of a half a mile each, and was raised to the shoulders of two coolies and carried thus, but at the end of the first half day two coolies could carry but one coil, and nearly half of the wire had to be relayed to the front, requiring that all carriers traverse the ground three times.

During the forenoon of the second day so many of the coolies became disabled from swollen and lacerated shoulders that some three miles of wire had to be abandoned on the trail, it being beyond the limit of human endurance to carry it further in the manner described.

It will be seen that four such carts as the one above described would have carried the amount of wire required for this expedition, and could have been drawn with less power, besides having the wire in shape to be reeled out without additional labor for that purpose.

Pack-mules and pack-ponies have given good service when the amount of this class of transportation was in abundance, but the amount of wire which one animal can carry is so small that their use becomes very extravagant when they are urgently needed for carrying commissary stores and ammunition.

One American mule can carry two half-mile coils of insulated wire for an entire day, and if necessary can carry three coils for a few hours over a good trail. Native Philippine ponies are hardy and require little feed, but as they weigh scarcely more than 600 pounds, the load must be reduced not to exceed 200 pounds.

The caribao, or water buffalo, usually draws his load upon a heavy two-wheeled cart, but makes a valuable pack animal during the rainy season when the roads are deep with mud. He travels with ease where a horse would be unable to get out alive, and thus compensates for his slow speed of from two to three miles an hour.

In summarizing the account of field telegraph lines it may be said that with one or two exceptions, where communications were not requested, no military expeditions have been undertaken in the Philippines without being accompanied by the field telegraph line, and the captured territory occupied simultaneously by the troops, and the establishment of a telegraph office ready to report the success of the expedition, its casualties, and to requisition for needed supplies.

The men who have undertaken this work have had to traverse, in working back and forth, two or three times the distance covered by the troops of the line of the army, at the same time working as hard as men can under a tropical sun, to keep up with the advancing column. When night came, and the troops went into camp for a well-earned rest, the men who had labored through the day would each take his turn at the instrument clearing the business of the previous day.

Lightning Arresters.

TO THE EDITOR OF THE ELE TRICAL REVIEW:

In your report of the proceedings of the International Association of Municipal Electricians, on page 289, issue of September 7, I note you say: "Mr. Petty advocated the abandoning of lightning arresters." This is not strictly correct. What I did advocate was the abandoning of the lightning arresters *in the boxes*, and the *use* of arresters such as are used on electric light and power circuits. Will you kindly make this correction, as I do not wish to appear as advocating the abandonment of such an absolutely essential protector as a lightning arrester.

WALTER M. PETTY.

Rutherford, N. J., September 9.

The Street Railway Convention.

President Vreeland, of the Metropolitan Street Railway Company, of New York, has asked Mayor Van Wyck to address the Association of Street Railways of the United States, when it convenes in this city on September 31. Mayor Van Wyck referred the request to President Guggenheimer, who will make the address to the association in Madison Square Garden. Elaborate preparations are being made for the three days' session of the street railway men, and President Vreeland has said $40,000 would be spent in entertaining the guests.

Halle-Merseburg Electric Railroad.

United States Consul Warner reports from Leipzig that work has been begun on the electric railroad between Halle and Merseburg, permission for the construction of which was granted by the Prussian Government several months ago. It is expected that the Halle-Ammendorf section will be completed before the beginning of winter. The total length will be 10 miles. Power will be obtained from the River Saale. The consul also states that the projected electric railroad between Leipzig and Halle has been abandoned, the Prussian and Saxon governments having refused to grant the necessary franchises.

Officers of the Association of Edison Illuminating Companies.

At the meeting of the Association of Edison Illuminating Companies, held at Buffalo, N. Y., last week, which was exclusively reported in the ELECTRICAL REVIEW for September 14, the following officers were elected:

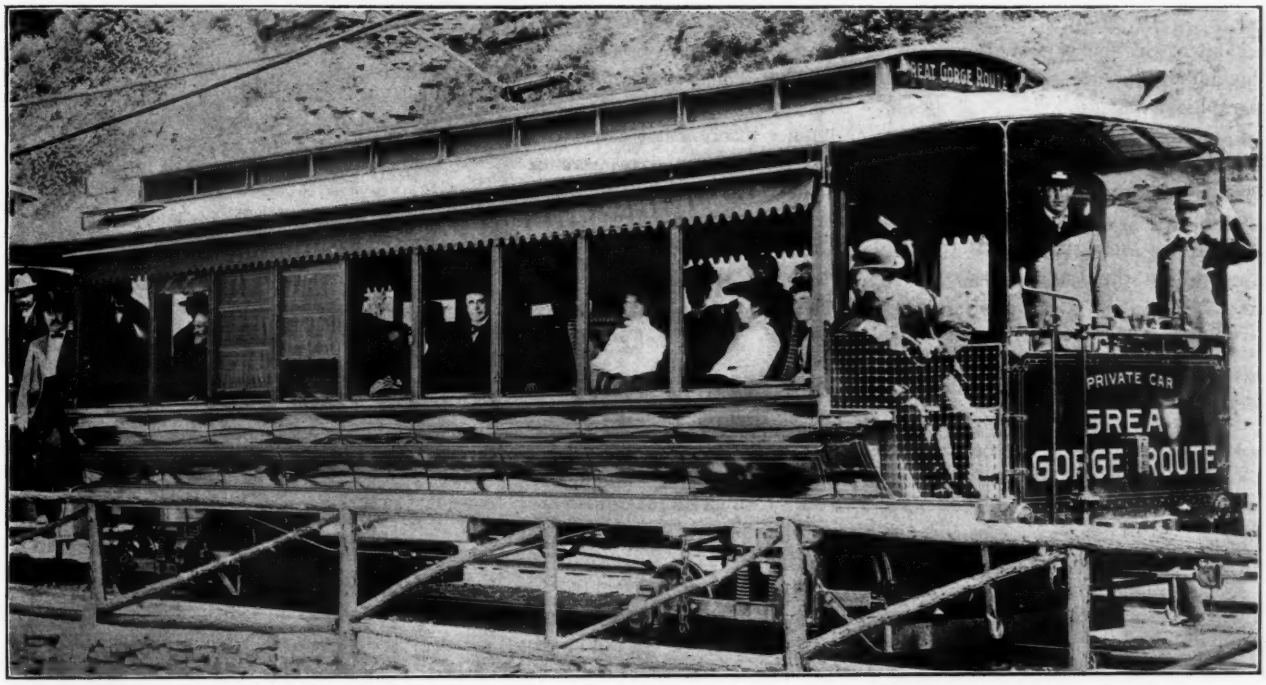
President, Louis A. Ferguson, Chicago, as announced in the ELECTRICAL REVIEW last week; vice-president, A. W. Field, Columbus, Ohio; treasurer, Alex Dow, Detroit, Mich.; secretary, Walter H. Johnson, Philadelphia; assistant secretary, Wilson S. Howell, New York. Executive committee: Louis A. Ferguson, chairman, Chicago; Charles L. Edgar, Boston; John W. Lieb, Jr., New York; W. C. L. Eglin, Philadelphia; Thomas E. Murray, New York; Samuel Insull, Chicago, and the following *ex-officio* members: A. W. Field, Alex Dow and Walter H. Johnson.

Mr. L. A. Ferguson, the newly elected president, is also first vice-president of the National Electric Light Association, of which body he has long been an important and influential member. Although still a young man, Mr. Ferguson has earned a wide reputation as an able and skillful electrical engineer, particularly in all that regards central station management and operation. He is the general superintendent of the Chicago Edison Company and under his administration of that corporation's affairs it has achieved signal success.

The association provided luncheon at the meeting-room each day, and also furnished the delegates with special cars for the "Gorge" ride down the Canadian and up the American side, with dinner at the International Hotel, Niagara Falls, and a view of the rapids illuminated by searchlights. The visit to the falls took place on Wednesday afternoon and evening.

On Thursday evening the delegates were the guests of the Buffalo General Electric Company, at Alt Nürnberg, on the exposition grounds, where a banquet was served to the ladies and gentlemen. The occasion was enjoyed by all and remarks were made by Messrs. Huntley, acting as toastmaster, Lieb, Ferguson, Stetson, McCall, Price, Dow and Charles W. Price.

The place for the next meeting will be decided by the executive committee.



ONE OF THE LAST PHOTOGRAPHS OF PRESIDENT MCKINLEY.

TAKEN AT NOON, FRIDAY, SEPTEMBER 6, IN THE NIAGARA GORGE ABOUT FOUR HOURS BEFORE THE PRESIDENT WAS SHOT.—COPYRIGHT BY C. D. BRINCKERHOFF.

Copper Welding.

Professor J. R. McCall gives the following directions for welding copper in the *Record* of the University of Tennessee: The copper should be treated with potassium nitrate and a cyanide, after which it is welded to itself, or to iron or steel, in the same way that iron is welded in the ordinary forge shop. A clean fire of coke or charcoal and a temperature of the copper considerably below a white heat ensure the best results. A temperature above this makes the metal brittle in working, while one much below will not give sufficient fluidity to the flux. In tension tests the welded joints developed practically the whole strength of the copper.

Meeting of the British Association for the Advancement of Science.

The British Association for the Advancement of Science met at Glasgow, September 11, 1901. At this meeting, Professor A. W. Rücker, the eminent physicist recently elected to the presidency of the University of London, presided, and delivered the inaugural address. The public lectures were delivered by Professor W. Ramsay, whose subject was the "Inert Constituents of the Atmosphere," and by Professor Francis Darwin, on the "Movements of Plants."

In Section A (mathematical and physical science) the president, Major P. A. MacMahon, first gave an account of the Mathematical Society of Spitalfields, 1717 to 1845, and after some remarks upon the present state of mathematics and physics in Great Britain and the teaching of those subjects, he concluded by considering the work of a specialist in science, and especially of a mathematical specialist in relation to the general advance of scientific knowledge.

The title of the address delivered by Professor Percy Frankland, F. R. S., president of Section B (chemistry), was the "Position of British Chemistry at the Dawn of the Twentieth Century." He drew attention to the factors which were instrumental in promoting the growing activity in original investigation during the past 20 years. Coming up to the present time, he pointed out the disadvan-

tages under which students of chemistry labored at the universities and indicated some more important reforms which he considered desirable in the immediate future.

Mr. John Horne, of the Geological Survey Office, Edinburgh, chose as the subject of his address "Recent Advances in Scottish Geology." He reviewed the progress of Scottish geological works since the last meeting of the association at Glasgow. In Section D (zoology) Professor J. Cossar Ewart summarized the results of the long series of experiments which he has been carrying on at Pennycuik, in connection with the subject of "Inheritance and Telegony." Dr. Hugh Robert Mill is the president of Section E (geography), and in his address he dealt with "Research in Geographical Science."

In his presidential address to Section F (economic science and statistics) Sir Robert Griffen discussed the increase in population during the last 100 years in the chief European countries, in the United States and in the English-speaking colonies.

Section G (engineering) was presided over by Colonel R. E. Crompton, who dealt with the probable future developments of passenger and goods transport as affecting railways, tramways and ordinary roads, and then touched on the standardizing of parts of machines to facilitate manufacture, and concluded with a consideration of the National Physical Laboratory.

In Section H (anthropology) Professor D. J. Cunningham, F. R. S., of Trinity College, Dublin, devoted his address to a consideration of the part which the brain has played in the evolution of man.

In his presidential address to Section I (physiology) Professor McKendrick reviewed the advance of knowledge in this branch of science during the past quarter of a century, and discussed some of the problems of what may be called "molecular physiology."

Professor I. Bayley Balfour was president of Section K (botany). He dealt in his address with the construction of flowering plants with the intention of showing that they owe their position as the dominating vegetation of the present epoch to their having solved best the problem of adequate water carriage. The new Section L (educational science) was under the presidency of Sir John Gorst.

If it contains less than five per cent of aluminum, tin solder can be used to solder aluminum bronze. If over five per cent, a good solder consists of 20 per cent zinc and 15 per cent cadmium. The surfaces are cleaned, a first and second layer of solder is laid on, the excess is removed with a brass scratch-brush, and the pieces are then soldered as usual.

American Association for the Advancement of Science.

The meeting at Denver was notable in several particulars. It was feared that a meeting in the West would be poorly attended, but the registration reached 311, which is larger than that of the second Detroit and Madison meetings, and nearly as large as that of the Columbus and fourth Buffalo meetings. There were a very large number of representative men of science present, and the sectional meetings were well attended and full of interest. More than 200 papers were presented.

Several important changes in policy were either adopted or presented for future action at the Denver meeting. One of the most radical measures under discussion was that which contemplates a change in the time of the annual meetings. The summer meeting has become such a fixed part of the annual programme of many members that a change to mid-winter calls for a considerable readjustment. The movement for a general convocation week following the holiday week has commended itself so generally to universities, however, that the association has concluded that the experiment deserves a trial. The general committee of the Denver meeting has accordingly suggested that the annual meeting in 1903 be held at Washington during the week in which January 1 falls. This suggests simply the experiment of a winter meeting without any recommendation regarding the discontinuance of summer meetings. It may be that the association will conclude to hold two meetings a year, which could well be of somewhat different character.

An amendment was adopted providing for representation in the council from the affiliated societies. It seems that this representation in the ruling body of the association would lead to a more compact and efficient organization of the scientific interests of the country. An amendment also was adopted which provides that the council should have power to change either time or place of meeting. It is understood that this power will be exercised only in such extreme cases that the action will commend itself to all members.

With the idea of increasing the efficiency of sectional organization, another amendment proposes that secretaries of sections be elected for a term of five years. Under the present method a secretary serves only long enough to learn his duties, which makes it impossible to obtain that continuity of experienced service which is necessary to develop the interests of the sections.

The committee on the policy of the association made three recommendations which were adopted. One was that Section D (mechanical science and engineering) be not discontinued as had been suggested, since the recent entrance of a large body of engineers into the association gives promise of a strong section. The second was the organization of the new Section K (physiology and experimental medicine), which promises to be one of the strongest sections of the association. A third was that all the abstracts be restricted to 400 words, that they be published in *Science,* and that the titles only shall appear in the published volumes of the proceedings.

Within the past year there has been a very large increase in the number of members of the association. At the last New York meeting there were 1,721 actual members, while at the close of the Denver meeting, about a year later, the number of members is, approximately, 2,800, over 1,150 members having joined within the last year.

The financial side of the association is becoming very impressive. The report of the permanent secretary for 1900, which does not include the still larger income accruing thus far during 1901, shows receipts amounting to $12,321.60. Of this amount the sum of $1,300 was paid over to the treasurer for endowment, and a balance of $4,741.60 carried over to the next year. To meet the numerous expenses of so large an organization, and also to set aside more than $1,000 toward the permanent endowment for grants, is an achievement for which the administration of the association should be congratulated. The treasurer's report shows that the permanent fund now amounts to $11,000, having been doubled in seven years.

The following is a list of the officers elected to serve at the next meeting: President, Asaph Hall, U. S. N. (retired); permanent secretary, L. O. Howard, chief entomologist agricultural department, Washington, D. C.; assistant permanent secretary, Richard Clifton, agricultural department, Washington, D. C.; general secretary, D. T. McDougal, director of the laboratories New York Botanical Gardens; secretary of council, Professor H. B. Ward, of the University of Nebraska; treasurer, Professor R. S. Woodward, Columbia University.

Officers of sections:

A (mathematics and astronomy), vice-president, G. W. Hough, Northwestern University; secretary, E. S. Crawley, University of Pennsylvania.

B (physics), vice-president, W. S. Franklin, Lehigh University; secretary, E. F. Nichols, Ohio State University.

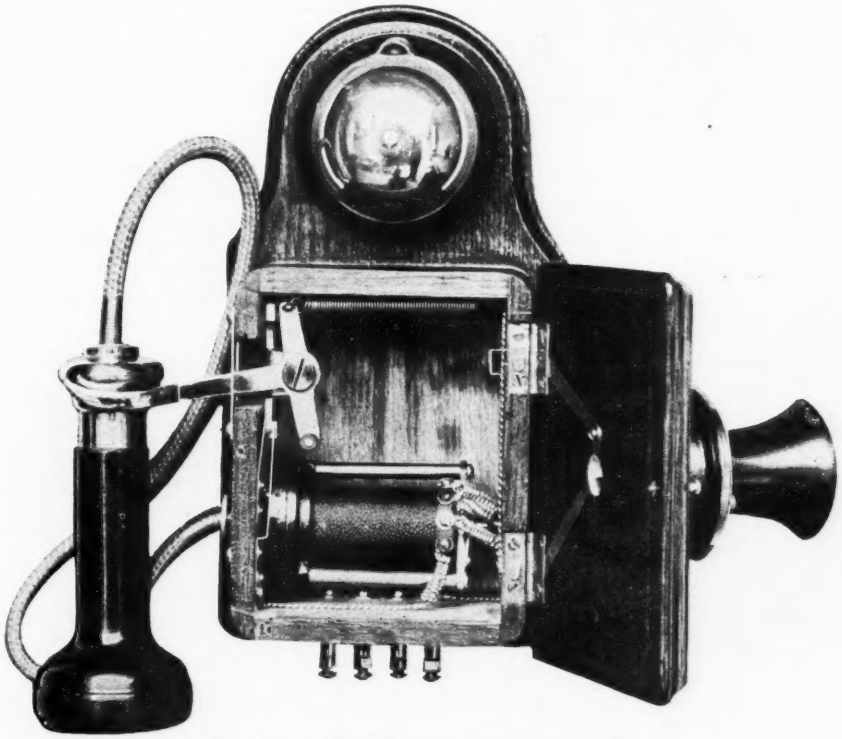
C (chemistry), vice-president, H. A. Weber, Ohio State University; secretary, F. S. Phillips, Western University.

D (mechanical science and engineering), vice-president, J. J. Flather, University of Minnesota; secretary, C. A. Waldo, Purdue University.

It was decided that the association meet at Pittsburgh in the summer of 1902, from June 28 to July 3, inclusive. The general committee recommended also that a meeting be held in Washington, D. C., during convocation week, or the week in which the first of January falls in 1903.

A New Telephone.

In constructing its No. 1 telephone the International Specialty Company, of Chicago, Ill., has sought to accomplish two things; first, the building of a good working telephone, and second, to make it so cheap that it might be available for use by every one. All the woodwork on this telephone is highly finished in antique oak. It occupies a space nine and three-quarters inches long and five and one-eighth inches wide, and with the transmitter and mouthpiece is six and one-half inches deep, which makes it a very compact telephone and gives it a handsome appearance.



NEW TYPE OF INTERCOMMUNICATING TELEPHONE.

The signaling is done by means of a push-button placed on the right side of the telephone box in plain sight of the user, the binding-posts for the connection of the telephone with the line at the bottom of the box being four in number, two for the line wires and two for the battery wires.

A specially wound induction coil, placed on the inside of the telephone box, the secondary coil being placed next to the core of the coil and the primary winding on the outside, constitutes the receiving element as well as serving the usual purpose of an induction coil. The receiving diaphragm is placed at one end of this induction coil, the sound being transmitted to the ear by a rubber tube and wooden earpiece similar in outward appearance to the receiver cords and receivers used on ordinary telephones. The tube is fastened to the telephone box by a long-threaded screw, and is protected by springs placed at the junction of the tube with the telephone box and with the earpiece. The tube is furnished with a handsomely braided cover. A carbon-grain transmitter is used.

All the working parts of the telephone are compactly arranged within the telephone box, thus preventing any possibility of injury or damage by careless handling. The interior wiring is done with the best quality of annunciator wire, all permanent connections being soldered.

The telephone works with any ordinary battery on any ordinary line and may be used either as an intercommunicating instrument or placed in connection with a switchboard or annunciator. It may be used in hotels, stores, offices, etc., desiring a private exchange, or for exchange work.

According to the *Zeitschrift für Elektrotechnik* the Hungarian Minister of Commerce has been in consultation with Messrs. Ganz & Company's engineers on the subject of the conversion of the Hungarian state railways to electric working. Three lines are named as the probable subjects of immediate experiment. From tables published in the same issue of our Vienna contemporary there would appear to be about 155 miles of electric tramway and light railway at work in Austria at the end of last year, and in Hungary just under 100 miles.

The Milwaukee Exposition.

That there are "other" things which "make Milwaukee famous" was conclusively proved by the scene which greeted the eye of the visitor to the twenty-first season of the Milwaukee Electrical and Industrial Exposition, which began on the evening of Saturday, September 7, 1901.

When Mayor Rose touched the button which started the machinery, a flood of light fell from great clusters of incandescent lights located in all parts of the building, and exposed to the view of more than 5,000 delighted "first nighters" a sort of industrial fairyland.

There is an interesting art display and many commercial exhibits of various kinds, but the electric features of the show are most prominent and would do great credit to any city in any country.

Among the interesting exhibits which have already been installed may be mentioned the Milwaukee Electric Company and the Browning Manufacturing Company, with their complete lines of standard dynamos and motors; the Cutter-Hammer Manufacturing Company, with its famous rheostatic devices which are known throughout the world; the Johnson Electric Service Company, of Milwaukee; the Submerged Electric Motor Company, of Menominee, Wis.; the Wisconsin Electrical Supply Company; the Western Electric Company, of Chicago and New York, which has lately established a branch in Milwaukee under the management of Mr. Harry Byrne, and which has allotted to it the largest space of any electric company in the building. The Stromberg-Carlson Telephone Manufacturing Company, of Chicago, also has a large space in which is installed a highly interesting exhibit of its well-known switchboard and telephone system.

This year's exhibition promises to be the most complete in the history of Milwaukee, and is a high testimonial to the energy and intelligence of this splendid Wisconsin city.

Professor Jones's Papers on Electrochemistry.

[*From the Electrochemist and Metallurgist. London.*]

In its issue of July 20, our enterprising contemporary, the ELECTRICAL REVIEW, of New York, ever alive to the necessities of the times, started a series of articles, entitled "Selected Chapters in Electrochemistry," by Professor H. C. Jones, of the Johns Hopkins University, whose excellent little book on the "Theory of Electrolytic Dissociation" we recently had the pleasure of reviewing. The first chapter is on osmotic pressure, and is followed by one on electrolytic dissociation.

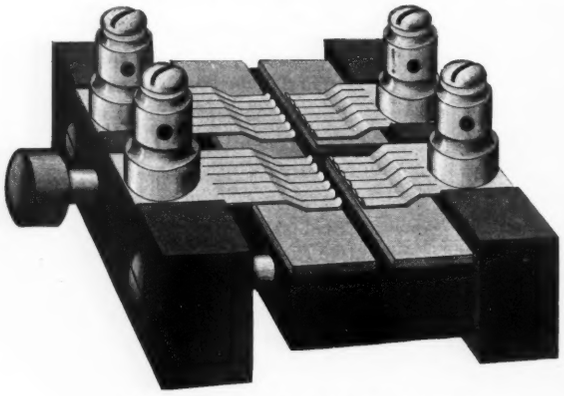
Mr. W. S. Barstow.

Mr. W. S. Barstow, formerly manager of the Edison Electric Illuminating Company of Brooklyn, from 1889 to 1901, has opened an office as consulting engineer at 11 Broadway, New York city. Mr. Barstow expects to devote a large part of his time to the development of street railway undertakings, and has already been retained by Messrs. Spencer, Trask & Company as consulting engineer for all of their numerous electrical properties, both railway and lighting.

He graduated from Columbia University in 1887, and after a period of service in the Edison Machine Works, at Schenectady, he joined the Brooklyn company. His wide knowledge of both the financial and technical phases of electrical enterprises, gives his opinion upon these matters great weight.

A New Fire-Alarm Cutout.

This device, which is known as the Miller cutout, is for protecting the boxes of fire and police departments against any sudden large currents of electricity, whether due to lightning or to the wires being crossed by other wires bearing heavy currents. It is simple, and is said to be effective in its workings and very difficult to get out of order. It is in use in a large number of cities throughout the country, where it is said to be universally commended. Its advantages are explained at a glance by the accompanying illustration. This cutout is manufactured by the Rochester Electrical Manufacturing Company, of Rochester, N. Y.



A New Type of Fire-Alarm Cutout.

The Duke and Duchess of Cornwall will travel in some of the finest electric cars in America when they go out from Quebec to see the Montmorency Falls. An order for four special cars has been given to the Ottawa Car Company. They are to be used for the first time when the royal visitors are in the ancient capital.

Automatic Time Switch.

The accompanying illustrations show an automatic time switch. It is known as the "Acme" time switch, and is manufactured by the Acme Switch Company, of Hartford, Ct. In it a distinct advance in switches of this kind is claimed, and it is stated that its practical success has been thoroughly demonstrated by service tests on central station circuits.

Mr. W. S. Barstow.

In mechanism the switch is extremely simple. It employs an ordinary clock movement in connection with a few attachments which add a minimum of complication. Two disks are secured on each side of the striking spring and on the same arbor, the one toward the face corresponding to the usual clock striking disk and the one toward the back controlling the switch. The time mechanism has otherwise been changed merely so that the usual finger arbor shall make the full revolution in 24 instead of 12 hours. A disk is mounted on this arbor and on this disk are stamped the figures which correspond to the 24 hours of the day. Two pivot hours are concentric with this disk, one of which is clamped at the hour when the current is to be turned on the electric circuit and the other when it is to be cut off. As the disk revolves at the time fixed a projection on one of these arms engages with an arm connected to the usual striking arrangement of a clock. The striking arrangement is then released, when the switch disk, shown in Fig. 2, is instantaneously thrown over by the striking spring and the switch circuit closed. The disk is instantaneously thrown in the opposite direction and the circuit opened, when the disengaging arm makes a similar contact with the striking release arm.

In the various details of the device much mechanical skill is shown. Instead of depending upon a clamping device for example, to set the time-tripping arrangement a small hole at the periphery of the disk is entered by a pin on the time arm. Spring brass is used for this arm, which enables it to be drawn back from the face of the disk sufficiently for the insertion of the pin in the selected hole. It is obviously rendered impossible by this means for the time device to become disengaged. The switch device at the rear has also been worked out along extremely skillful mechanical lines and is a model of simplicity. An instantaneous brake is given, which is almost two inches long in the smaller sizes. In seven days the mechanism requires to be wound but once.

When the case is locked, as will be seen from Fig. 1, all the mechanism is wholly enclosed, which ensures against careless or incompetent employés and at the same time makes the case dustproof. The switch may be inserted at any convenient point in the circuit, and is intended particularly for the control of interior work and incandescent lamps and street arc lamps. The switch is made in sizes for a current of 15 to 50 amperes.

Fig. 1.—Automatic Time Switch.

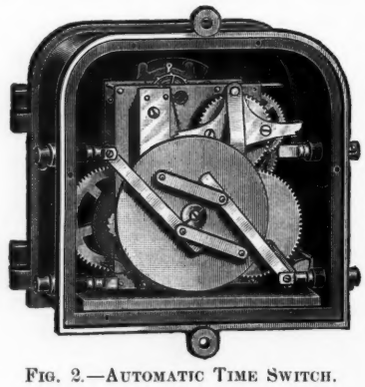


Fig. 2.—Automatic Time Switch.

Current Electrical News

COMMERCIAL NEWS

DOMESTIC AND EXPORT

The Peninsula Telephone Company is preparing to erect a line from Tampa, Fla., to Thonotosassa, thence to Plant City and other points.

Pahiatua, a flourishing town in New Zealand, is to have an electric traction system, which it is estimated will cost over $1,000,000.

The council of Ypsilanti, Mich., has received a petition for a telephone franchise from the People's Telephone Company, to establish a system in Ypsilanti.

A company has been organized in Kokomo, Ind., with a capital of $2,000,000, to build an electric railway from Indianapolis to Peru *via* Noblesville, Tipton and Kokomo.

The council of Norwalk, Ohio, has granted a franchise to the Pomeroy-Mandelbaum Syndicate to lay tracks for an entrance to the village of the extension of the Oakland, Elyria & Western Railroad.

The United Telephone Company, of Bluffton, Ind., and the Indiana Telephone Company, of Hartford City, have been consolidated. The capital of the new company, the United Telephone Company, will be $300,000.

It is stated that the Compania Mexicana de Fuerza Motriz, of Mexico, is making surveys with a view to erecting a power plant near Amealca in the state of Vera Cruz. At first it is proposed to operate a plant of 2,000 horse-power.

The Winchester Telephone Company, of Winchester, Va., has been sold to a Pennsylvania syndicate, which owns all the lines in the Cumberland Valley. At Winchester connections will be made with the long-distance line.

A new telephone company has been organized in Racine, Wis., to maintain a line from that place to Thompsonville. It will be known as the Franksville & Thompsonville Telephone Company. Mr. G. J. Ellis is the president of the company.

The Darlington Electric Light and Water Power Company, of Darlington, Wis., is now engaged in installing machinery for making pearl buttons. The large amount of clams taken from the river by pearl hunters has led them to make this move.

It is said that Mr. William Everett, of Cleveland, is the moving figure in the plan to extend the city and suburban railway of Washington to Ellicott City, Md., and there connect it with the lines of the United Railways and Electric Company, of Baltimore.

A large water-power plant is soon to be built at Fremont, Neb. The waters of the Loup River are to be tapped at Linwood, 46 miles from Fremont, and carried through a canal to a turbine installation, whence the water will pass to the Platte River. About 30,000 horse-power will be developed.

M. Raymond Miranda y Marion, of the City of Mexico, who has been recently granted a concession for the construction of a street railway in the suburbs of the Mexican capital, known as Colonia Americana, has applied to the municipal council for an extension of time to carry out the project.

The Appellate Division of the Supreme Court of New York has appointed Mr. Theron O. G. Strong, Thomas C. T. Crain and Henry C. Gray commissioners, to hold hearings and report to the court on the application of the Rapid Transit Commission for the extension of the Rapid Transit System to Brooklyn.

The work of constructing the Independent Telephone System has begun in Sherman, Tex. It will be pushed simultaneously at Sherman and Denison under the charter recently granted to the Grayson Telephone Company, which is authorized to do a local and long-distance telephone business in the county.

M. Marche, a French engineer, claims to have solved the problem of telephoning by submarine cables for long distances. His experiments are reported to have been very extensive and exhaustive and to have resulted recently in his being able to transmit a telephone message with perfect distinction from Calais over a cable 400 miles long.

The final plans to establish a through electric line from Toledo to Cleveland, Ohio, will be completed about September 25. At that time the stockholders of the Toledo, Fremont & Norwalk, the Cleveland & Lorain, and the Sandusky & Norwalk lines will meet with Messrs. Everett and Moore to ratify the action taken by the syndicate at a meeting on August 28, when traffic arrangements between the two roads were decided upon.

Mr. C. W. Morse, ex-president of the American Ice Company, offered a short time ago to buy at 50 per cent of the original price, the stock of any shareholder in the Telephone, Telegraph and Cable Company of America. As a result of his offer 248,000 shares have been deposited with the City Trust Company for Mr. Morse. Mr. Morse now has a controlling interest in the company, as 208,000 shares comprise two-thirds of the stock.

The Old Time Telegraphers' Association and the United States Military Corps have held a meeting in Montreal and elected officers for the ensuing year. The following were elected officers of the Old Time Telegraphers' Association: President, George H. Cone, of Ogden, Utah; vice-president, Belvidere Brooks, of Denver, Col.; secretary and treasurer, John Brant, of New York. The Telegraphers' Association will hold its next meeting in Salt Lake City, Utah.

The consolidation of the Mobile Street Railroad Company and the Mobile Light and Railroad Company has been perfected by the election of the following directors, who will serve for the ensuing year: Messrs. J. Howard Wilson, John Wilson, W. E. Gordon, C. W. Chase, Charles D. Willoughby, W. H. Patterson, Henry B. Tompkins, W. S. Brown and L. Lowenstein. In a few days the directors will meet and the officers of the new concern will be elected and other matters determined.

A company has ben organized in Colorado Springs, Col., to build an electric railway to the top of Pikes Peak. It is expected that the road will cost $500,000 or more. It will start from Colorado Springs, or from some station on the Cripple Creek Short Line. Experiments show that electricity can be operated without trouble at the altitude necessary, 14,143 feet. Work will be begun immediately. W. A. Otis & Company, of Colorado Springs, is among those interested in the new railway.

The Birmingham Railway, Light and Power Company, of Birmingham, Ala., which has a capital of $10,000,000, and controls all the street car lines, gas and electric power concerns in that city, has appointed Mr. George H. Davis general manager. Mr. Davis comes from the engineering firm of Ford, Bacon & Davis, of New York. He will have entire control of all the properties, and will look especially after the reconstruction of the various plants and the improvements which the company is to make and upon which $1,000,000 is to be expended.

If the State Railroad Commission decides to grant a charter to the New York & Portchester Railway Company, of New York, for a new suburban line at the hearing appointed for September 30, it is probable that Mr. John B. McDonald, the subway contractor, will take the contract for this construction. Mr. William E. Gotshall, president of the company, said that Mr. McDonald was so confident of the feasibility of an electric railroad to connect with the rapid transit system at 177th street, that should the company fail to do so, he has declared his willingness to execute the terms of the charter himself.

A company has been organized, and articles of incorporation will soon be filed, to construct a large electric power plant in Utah. The manager of the enterprise is Mr. W. C. Weaver, receiver of the Bear River Irrigation Company. His associates comprise New York, Chicago and Salt Lake City capitalists. The power-house of the new company will be built just south of Collinston in Box Elder County. It is the intention to erect a plant that will generate 5,000 horsepower of electricity. Pole lines will be run to Salt Lake, Ogden and Park City, as well as Bingham. The plant will cost $1,000,000.

It is rumored that a union of the electric railway and light companies in Philadelphia is now under way. This combination will involve more than $100,000,000. The principal companies to be merged are the Union Traction Company, which owns all the street railway lines in that city; the New Rapid Transit Companies recently chartered in that state; the Philadelphia Electric Company, which controls most of the electric light plants in Philadelphia, and the Electric Company of America, and the American Railways Company, which own electric street railways and electric light plants in many of the eastern states.

Notice has been sent out by the Central Union Telephone Company, of Chicago, for two special meetings of the stockholders, at which it is expected that the recent recommendations of the board will be carried out. At the first meeting, to be held October 1, the stockholders will be asked to reduce the capitalization to $3,481,500. At the second meeting, to be held October 17, the stockholders will be asked to increase the authorized capital stock to $10,000,000. After this increase the company will have the right to issue new stock at par from time to time, and payment for it will be in installments based on the needs of the company in extending its lines.

News comes from New Zealand that the Christ Church city council proposes to construct an electric traction system and to generate the necessary energy from the River Waimakariri. Recently Mr. Robert Hay, M. I. C. E., reported on the proposed scheme and considered that it was quite feasible to be carried out. He estimated the cost of the work from the intake at the Waimakariri race to the termination of the race at some $275,000. To this amount, however, would have to be added the cost of iron pipes and turbines with foundations for the same and turbines with connections, generators, switchboards, terminals, transformers, exciters, meters, buildings, etc.

ELECTRICAL SECURITIES

In financial circles, as in all others, the one great event of the week has been the tragedy at Buffalo. As is the custom in Wall street, all events either of good or evil import which can in any way be foreseen are generally discounted, and it was so with the death of President McKinley. It can safely be said that not only will there be no panic but there will be no approach to panic conditions, and that the general business of the country will proceed as safely, as conservatively and as profitably as it has in the immediate past. The general feeling of confidence which was shared by all citizens of the country up to the assassination of the President has barely been disturbed, and the new administration is believed, in the best informed circles, to be of a kind not calculated in the least to upset existing conditions.

While speculation may feel somewhat the shock of recent events the legitimate general business of the country will probably be in no way affected. It is not likely that any great amount of money will be put in circulation before the December settlements are made, and that during the intervening period there will be some flagging of interest in purely speculative securities. At the same time there is nothing in the present situation to impair confidence or to check the upward and satisfactory course of the country's business.

ELECTRICAL SECURITIES FOR WEEK ENDING SEPTEMBER 14:

New York:	Highest.	Lowest.	Closing
Brooklyn R. T...	69½	61½	62⅞
Con. Gas.....	222	215½	215¾
Gen. Elec.....	264½	251	253
Man. El.....	118¼	113¼	114
Met. St. Ry.....	166	159	160¼
Kings Co. Elec..	...	...	195
N.Y. & N.J.Tel.Co.	...	...	170
Telep.,Tel.&Cbl.Co.	...	...	5⅛

The Commercial Cable Company has declared the regular quarterly dividend of 1¾ per cent, payable October 1. Books closed September 20 and reopen October 2.

The executive committee of the Western Union Telegraph Company has recommended the declaration of a regular quarterly dividend of 1¼ per cent.

The statement of the Third Avenue Railroad for the quarter ending June 30, 1901, shows directly the results of Metropolitan methods in operation. With a gross increase in earnings of nearly $20,000 operating expenses have been reduced about 52 per cent. The abolition of the old management resulted in a saving of $100,000 per annum in salaries, and the equipment all being new there has been no necessity yet for expenditure for repairs.

The Manhattan Elevated Railway Company's directors have declared the usual quarterly dividend of one per cent. This is payable October 1, the books having closed September 13 to reopen September 25.

The Telephone, Telegraph and Cable Company of America, it is believed, has passed into the control of Mr. C. W. Morse, who is stated to have secured over two-thirds of the entire capital stock at 50 per cent of the actual amount paid in.

Boston, September 14:	Closing.
Am. Telep. & Tel.....	160
Erie Tel.....	40
New Eng. Tel.....	140
Mass. Elec. pf.....	98
Westing. Mfg. pf.....	73
Edison Elec.....	260

In accordance with the provisions of the lease of the West End Street Railway Company to the Boston Elevated Railway Company, a dividend rental of $1.75 per share will be paid to holders of record of West End common stock on October 1. Transfer books will close at the close of business September 17 and reopen October 2.

Philadelphia, September 14:	Closing.
Elec. Co. of Amer.....	7¼
Philadelphia Elec.....	5½
Union Traction.....	29
United G. I. Co.....	115
Elec. Stor. Bat. c.....	71
Elec. Stor. Bat. pf.....	78

Philadelphia Traction Company has declared a regular dividend of $2 per share, payable October 1 to stock of record September 14.

Chicago, September 14:	Closing.
Chicago Edison Light.....	165
Central Union Telephone.....	45
Chicago Telep.....	275
Un. Trac.....	17
Un. Trac. pf.....	58
Metropolitan El.....	91

PERSONAL MENTION

PROFESSOR SAMUEL P. LANGLEY, secretary of the Smithsonian Institution, has been elected a foreign member of the Reale Accademia de Lincei, of Rome.

MR. ELMER P. MORRIS, of the Morris Electric Company, of New York, which concern acts as the New York purchasing agent for the Havana Electric Railway Company, of Havana, and the Mexican Tramways Company, Limited, of the City of Mexico, has just returned from a business trip to Cuba.

THE DUTCH ACADEMY OF SCIENCES, at Haarlem, has elected to membership H. Haga, professor of physics at Gröningen. Foreign members have been elected as follows: H. Becquerel, professor of physics at the Ecole Polytechnique, Paris; Max Planck, professor of mathematical physics and director of the Institute for Theoretical Physics at the University of Berlin, and Heinrich Dubois, associate professor of physics at the same university.

LEGAL NOTES

POWER OF PROBATE COURTS—An attempt to confer upon probate courts the power to direct the mode in which telegraph or telephone companies may use the streets and alleys of a city or village, when the municipality and the company are unable to agree, is held, in Zanesville *vs.* Zanesville Teleph. & Teleg. Co. (Ohio) 52 L. R. A. 150, to be unconstitutional as an attempt to confer legislative power upon the court.

TELEGRAPH COMPANY'S LIABILITY—The Supreme Court of Illinois held, in the case of The Western Union Telegraph Company *vs.* North Packing, etc., Company, that damages recoverable for delay in the delivery of a message to an agent instructing him not to buy stock were not limited to the difference between the cost of such stock and the amount for which it could have been sold as soon as the agent received the principal's orders not to buy, where the agent was authorized only to buy and not to sell, and that in such a case it was not his duty to sell until he had opportunity to learn the principal's wishes in the matter.

AN AFFIDAVIT BY TELEPHONE LEGAL—According to Judge N. Charles Burke, of the Circuit Court for Baltimore County, Md., an affidavit by telephone taken by a justice or a notary is legal. Judge Davis has given his decision to that effect in the case of the petition of the Manor Lumber Company, of Baltimore County, asking for the recision of an order appointing Osborne J. Yellott receiver for the concern. When Mr. Yellott was ready to file the necessary papers asking for a receiver, he had Mr. Cross come to the telephone at Cincinnati, and Justice Thomas Butler, who knows Mr. Cross very well, took his affidavit to the bill. The contention was made by the attorney for the company that affidavits taken in the manner described were not legal and bona fide.

ELECTRIC LIGHTING

Mr. T. W. Roby, of Amherst, N. H., is to build an electric light plant in Topeka, Kan., costing $100,000.

The Utica Electric Light and Power Company has been awarded the contract for lighting the city of Utica, N. Y.

Work on the new power-house of the Saranac Lake Light, Heat and Power Company, of Saranac Lake, N. Y., is progressing rapidly.

The Staver Carriage Company, Chicago, Ill., is in the market for a 50-kilowatt electric light plant, including generators, engines, lamps, etc.

Mr. I. N. Stabler, of Fremont, Ind., has received a 25-year contract for an electric light plant in Fortville. The plant is to be completed by March 1, 1902.

The Keewatin Power Company is said to be negotiating for a power plant at Keewatin to transmit power to Winnipeg, Manitoba, a distance of about 120 miles.

The new electric light plant in Shamokin, Pa., is rapidly nearing completion. The entire building is now roofed over and completed all but finishing the office.

The plant of the Merchants' Electric Light Company, in York, Pa., is nearing completion, and it is probable that the new company will begin operations in October.

The council of Newbern, N. C., has ordered a special election to be held for the purpose of voting on the question of issuing $15,000 in bonds to purchase an electric light plant.

The council of Grass Lake, Mich., has granted a 30-year franchise to the Hawks-Angus Company for lighting the village, and also to run its electric road the entire length of Lake street.

Bids for the basement, power-house and tunnel from the power-house to the main building of the new West Des Moines high school, of Des Moines, Ida., will be received on September 23.

The Hughes Electric Company, of Minneapolis, Minn., has bought the lighting plant at Eveleth, owned and operated by Mrs. Florence Webster. The new company will build a new and larger plant for the town.

The voters of the town of Mt. Forest, Ontario, have authorized the purchase by the town of the works and property of the Mt. Forest Electric Light Company. This company was managed by Messrs. P. Corley and Collins.

The contract for furnishing electric lights for Shepherdstown, W. Va., has been awarded to the Shaff Light Company, of Chambersburg, Pa. There will be eight miles of wire and five arc lights, the other parts of the town being lighted by incandescent lights.

A meeting of those interested in the new electric light company of Johnstown, Pa., has been held. A temporary organization was effected and several important points were decided upon. The name of the proposed organization is the Consumers' Electric Light, Power and Heating Company, and it was decided to capitalize it at $200,000 instead of $125,000, as originally planned.

It is reported that Catonsville, Md., and the villages surrounding it are soon to be lighted by electricity. Subscriptions are being received by Mr. Arthur C. Montell, cashier of the First National Bank, of Catonsville. The Patapsco Electric and Manufacturing Company, which has acquired the old Gray's mill property on the Patapsco River near Ellicott City, will furnish the power.

ELECTRIC RAILWAYS

Work has been begun upon the electric railway in Little Falls, N. Y.

A plan is under way to build a trolley between Fishkill and Peekskill, N. Y.

The building of an electric railway from Mound City to Beechwood, Mo., is contemplated.

The new line to Boston, Mass., from Lowell through Tewksbury will soon be open for travel.

Work has been begun upon the street railway in El Paso, Tex. The Davis Company is doing the work.

The track-laying has been begun upon the Clinton end of the Utica Belt Line Construction in Clinton, N. Y.

Nearly all the rights of way have been secured for the Richmond & Portland Electric Line, of Richmond, Ind.

Connecting electric lines are to be built between the towns of Anderson, Middletown, Frankton and Lapel, Ind.

Good progress is being made in the construction of the Greenwich & Johnsonville Railway, of Greenwich, N. Y.

The work on the new trolley road which is to connect Warehouse Point, Ct., with Hartford, is going along rapidly.

A franchise for the construction of an electric car line in Sioux Falls, S. D., is being sought by eastern capitalists.

Messrs. Edward Kennedy and A. C. Rush have applied for a franchise to construct an electric railway in Beaumont, Tex.

Rights of way for the proposed railway between Farmington and Flat River, Mo., have been secured over most of the route.

Orders have been placed and shipments will soon be begun of the material necessary for the electric railway in Parsons, Kan.

A party of surveyors of the Farmington, Howell & Lansing Electric Road, of Lansing, Mich., has just finished its labors there.

The council of Syracuse has granted a franchise to the Syracuse-Rochester Electric Railway to lay tracks through that town.

The council of Duluth, Minn., has adopted a resolution directing the street railway company of that city to extend its lines.

Those interested in the Beloit, Delavan Lake & Janesville electric line have secured a franchise through the city of Lake Geneva, Wis.

The right of way has been secured for nearly the whole distance for the electric railroad between Grand Rapids, Mich., and Belding.

The Schenectady Railway Company, of Schenectady, N. Y., has been granted a franchise for certain extensions by the highway commissioners.

It is expected that the work of construction of the Newark & Marion Trolley Line, of Marion, N. Y., will be begun within a very short time.

A petition has been made to the common council of Iron Mountain, Mich., for a franchise to build an electric road from that city to Niagara, Wis.

The council of West Homestead, Pa., has granted a franchise to the Homestead Street Railway for an electric railway through the streets of the town.

Within a short time the towns of Biddeford and Saco, Me., will be in trolley connection with Portland, the road now having been nearly completed.

The police jury of Houma, La., has granted a franchise to Mr. L. H. Lancaster and others for an electric trolley line between Houma and Thibodeaux.

The board of aldermen of Platte City, Mo., has granted a franchise for the Kansas City, Platte City & St. Joseph Electric Railway to pass through that place.

An extension to its power plant, under the viaduct, is being built by the Cleveland City Railway Company. A new boiler house will be erected, 80 feet square.

The engineers have started the running of the line of the trolley road which is to connect the towns of Chambersburg, Greencastle and Waynesboro, Pa.

At a recent meeting of the town council of Atlanta, Ill., a franchise was granted to the Bloomington & Springfield Interurban Railroad for a period of 20 years.

The Amsterdam Street Railroad, of Amsterdam, N. Y., has filed a certificate with the secretary of state showing the proposed extension from Akin to Tribes Hill.

Work will soon be begun upon the construction of the extension of the Scioto Valley Electric Railway in Columbus, Ohio. Mr. W. H. Luchtenberg has the contract for the work.

At a special meeting of the city council of Edwardsville, Ill., the Bellsville Traction Company has been granted a franchise over Buchanan street from Wolf street to the city limits.

The Manhattan Elevated Railway Company, of New York, is erecting a large structure at Third avenue and 161st street for a power storage house for the third-rail system.

The officers of the Buffalo & Depew trolley line, of Buffalo, N. Y., are making arrangements to extend the line from Burlington avenue, in Depew, to Central avenue, Lancaster.

Mr. C. A. Sumner, of Los Angeles, Cal., has secured a franchise for an electric railway system to be established on Adams street, from Western avenue to the western city limits.

A petition has been presented to the city council of Iron Mountain, Mich., by the Menominee Range Street Railway Company for a franchise for a street railway through that town.

The citizens of Arvada, Cal., are raising subscriptions for a new trolley line. The work will begin about September 30, and the company intends to complete the line to Arvada December 1.

With the exception of a short strip, the Cincinnati, Lawrenceburg & Aurora Electric Railway Company of Ohio has obtained all the rights of way for the extension of its line from Aurora to Vevay.

The Doyleston & Willow Grove Railway Company, of Doyleston, Pa., has filed notice of an extension of its route from Hatboro to Hartville, and has secured consent from the township's supervisors.

Mr. John A. Nolan, of Buffalo, N. Y., is securing the right of way along the route of the proposed trolley road of the Rochester & Southern Traction Company, from Rochester to Hornellsville, N. Y.

The Washington Electric Street Railway Company, of Washington, Pa., is to build a trolley line from the terminus of the present line at Tylerday through the new industrial section, a distance of three miles.

A franchise giving the Chicago & Milwaukee Electric Railway Company entrance into Libertyville, Wis., is assured. The company will build its branch from Lake Bluff during the coming fall and spring.

Messrs. Gard & Seiverling, contractors of Kalamazoo, Mich., have been awarded the contract for the construction of the Northern Ohio Traction Company's new line between Akron, Canton and Massillion, Ohio.

Grading is now in progress along the entire line of the Tacoma-Seattle Electric Railway, of Tacoma, Wash. The directors are making good progress, and it is intended to have the work finished by November 1.

It is reported that work is to be begun at once on a new line between Butler, Pa., and Newcastle, which will give Buffalo, Rochester and Pittsburgh an independent line between those points and an outlet to the West.

The council of Downington, Pa., has passed an ordinance which permits the Tennis Trolley Company to use the streets. It is understood that the line will be built and ready for business before the beginning of next year.

Mr. P. F. McCann, of Greensburg, Pa., has been awarded the contract by the Pittsburgh, McKeesport & Connellsville Street Railway Company for the construction of its line from Scotdale to Moorewood by way of Mt. Pleasant, a distance of seven miles.

Messrs. Pasco & Davison, proprietors of the planing mill in Louisville, N. Y., have sold their plant and water privilege to the Hudson Valley Railway Company for a power station. It is reported that the price paid was $13,000.

It is expected that the electric railway line from Worcester, Mass., to Danielson, Ct., a distance of 40 miles, will be completed and in running order about the middle of December. The work is now being pushed as rapidly as possible.

Articles of association for the formation of a street railway corporation to be known as the Ludlow & Holyoke Street Railway, of Holyoke, Mass., have been published, and after the legal requirements are met, a corporation will be established.

A meeting of the Greenfield & Deerfield Street Railway Company has been held in Greenfield, Mass. Mr. F. E. Pierce was elected president. It was voted to proceed immediately with the construction of the line from Greenfield southward.

Messrs. S. W. Smith and J. E. Sawyer, of Pontiac, Mich., who are interested in the Pontiac-Flint Electric Road, have received news from New York to the effect that the financial end of their enterprise has been satisfactorily adjusted.

Mr. John Martin, of Ohio, who recently obtained a franchise from the city of Tampa, Fla., to construct a suburban trolley line, is contemplating running a line from Tampa to Thonotosassa, and thence to Plant City. The line is to be one of rapid transit, capable of making 60 miles an hour.

The plans for the power-house to be erected in Jackson, Mich., by the Boland Electric Railway are now about completed. The work of constructing the plant will probably be commenced in a few days. The power-house is estimated to cost about $300,000.

The right of way is being purchased from the farmers of Jefferson and Mill townships for the proposed traction line which is to run from Gas City through Upland to Hartford City, Ind. There it will be connected with another line to connect with Hartford City and Muncie.

A new electric line known as the Camden

& Trenton Line is being agitated. It is to connect Philadelphia and New York. A survey covering a new route through West Trenton marks the beginning of a rival for the proposed Johnson line from the Delaware to the Hudson.

A party of surveyors has finished the survey for an electric railway to be built from Indian Harbor, Ind., to Michigan City. The engineers are in the employ of the Chicago & Indiana Air Line Railway Company. Work on the line has already commenced at Indian Harbor, and the entire road will be rushed to completion.

Work has been commenced upon the street railway which is to connect new Kensington and Parnassus with Tarentum, Pa., and other points on the western side of the Allegheny River. The Mellons own the franchises and have awarded the contract for building the road to the Tennis Construction Company, of Pittsburgh.

From present indications it looks as though the city of Augusta, Me., would be a centre of electric railway systems in that state. Several railways are now being operated there. A company of men have filed a preliminary application for a charter for an electric line to Togus with the railroad commissioners of the state.

A franchise in Florida has been secured by the Little Miami Traction Company. The proposed road is from Tampa to St. Petersburg, a distance of 50 miles, through one of the most populous and productive sections of Florida. The work will probably be begun this fall, and will cost in the neighborhood of $1,000,000.

President Ray, of the Woonsocket Street Railway Company, of Woonsocket, R. I., has announced that the plans have been drawn and all rights secured for the ten-mile extension of the Woonsocket Street Railway Company, of Pascoag. This will be built by the Columbia Street Railway Company, and leased by the Woonsocket company.

The Milwaukee, Burlington & Lake Geneva Railway now holds a very valuable franchise in Milwaukee, Wis. The franchise is for an electric elevated road, and is unlimited as to time and permits the running of freight trains through the city. The central terminus of the road is on Michigan and Milwaukee streets in Milwaukee.

The plans for the power-house of the Berkshire Street Railway Company, of Pittsfield, Mass., have been completed, and the contract will soon be awarded. The building will be of brick, one story high and 104 by 109 feet in size. The structure will be as nearly fireproof as possible, with steel beams and arches and steel truss roof and monitors.

The contract between the city of Lynchburg, Va., and the Lynchburg Traction and Light Company has been signed. The contract is to continue for 32 years from May 1, 1901, and authorizes the company, which is the consolidation of two previously organized companies, to construct and maintain a street railway to convey electricity for light and power and to light the city.

The Greensboro Electric Company, of Greensboro, N. C., which is to build an electric street railway in Greensboro is pushing the work. Orders have been placed with the Fitchburg Steam Engine Company for three 300-horse-power tandem compound engines for the use of the plant. The work of laying the street railway track will soon be begun and will be pushed rapidly to completion.

The Fairhaven & Westville Railroad Company is to receive permission to extend its line to Derby, Ct. Judge Gager of the Superior Court of that state has heard the petition of the road for the court's approval of its franchise, and nobody having appeared in opposition, he said that he would issue an order showing that public necessity and convenience demanded the building of the extension.

The Wabash & Mississippi Construction Company of Illinois, which was organized and incorporated about three years ago by Dr. W. C. Irwin and others, has been reorganized, and Dr. S. D. Mercer, who has been interested in railways in Omaha, Neb., has acquired an interest in the company. It is the intention of the company to construct an electric railway line from Lawrenceville, Ill., to East St. Louis.

Mr. Thomas G. Barker, of Boardman Brothers & Company, San Francisco, Cal., will apply for the sale of a franchise for the building and operation of an electric railway in Redding, Cal. The proposed route is four and a half miles in length, traverses the main business and residence streets and runs through the additions to the town. It is estimated that the road can be built and equipped for $80,000 per mile.

The annual report of the Metropolitan Street Railway Company, of New York, N. Y., for the year ending June 30, 1901, furnished to the Railroad Commissioners at Albany on Saturday, makes the following showings and comparisons:

	1901.	1900.
Gross earnings	$14,063,781 92	$13,785,083 94
Operating expenses	6,755,130 94	6,631,2.3 66
Surplus	7,808,650 98	7,153,830 28
Fixed charges	4,534,068 22	4,445,720 44
Net earnings	2,774,582 76	2,708,109 84
Other income	656,984 63	652,049 70
Net income	3,431,567 39	3,360,159 54
Dividends declared	3,393,262 25	3,145,891 00
Surplus over dividends.	$38,305 14	$214,268 54

These figures are based on the same track mileage as last year, and, except for the final 30 days, cover operation on main lines by the old cable. This practically excludes from the showing any of the economies resulting from the conversion from cable to electric traction, the full effect of which will be apparent during the current year. During the last half of the year covered by the report dividends were paid on $52,000,000 instead of $45,000,000, as formerly. The increased cost of operation was made in the period during which the company's main lines on Broadway, Columbus and Lexington avenues were under alteration from cable to electric traction.

AUTOMOBILE NOTES

The example of the Paris fire board in employing motor fire engines is to be emulated by the London fire brigade. It is anticipated that by this means the time in reaching fires will be considerably shortened and less space will be occupied during transit of the engines through the narrow streets. It is proposed to build the engines in the fire department's own workshops, since this will be cheaper than if the engines were built by a private firm.

In Paris a new electric fire pump, which contains 100 gallons of water and is ready to start for a fire at any moment, is proving quite a success. It has an electric outfit on the Bouquet, Garcin & Schivre system with the necessary storage batteries. In the report of the colonel of the firemen's regiments an instance is pointed out where the new fire pump rendered an important service. Owing to the fact that it arrived quickly at the fire with its water reservoir and its pumps already to act it was the means of preventing an explosion of a cellar full of chemical products. It is stated in the report that the horse fire engine would have arrived too late, and that the hose would not have been coupled to the nearest fire-plug in time to prevent the explosion.

NEW INCORPORATIONS

LANSING, MICH.—The People's Telephone Company. $200,000.

BOWLING GREEN, OHIO—The Wood County Telephone Company. $200,000.

EAST PITTSBURGH, PA.—The Union Telephone and Messenger Company. $1,250.

MARION, OHIO—The Columbus, Marion, Tiffin & Toledo Electric Railway. $20,000.

EVANSVILLE, IND.—The Cumberland Telephone and Telegraph Company. $6,237,600.

LOUISVILLE, KY.—United States Traction Company. $30,000. To operate rapid transit plants.

OTTUMWA, IOWA—The Ottumwa Telephone Company. Capital stock increased from $75,000 to $120,000.

WASHINGTON, D. C.—The Light, Heat and Power Company. Capital increased from $200,000 to $1,000,000.

ORANGE, TEX.—Orange Telephone Company. $40,000. Incorporators: Melville S. Shaw, Walter D. Betters and others.

MILWAUKEE, WIS.—The Independent Consolidated Telephone Company. $500,000. E. T. Fairchild, of Milwaukee, is the president.

DALLAS, TEX.—Texas State Fair Miniature Electric Railway Company. $3,000. Incorporators: A. P. Lipscomb, Henry Garrett and others.

TAYLOR RIDGE, ILL.—Farmers' Independent Trunk Telephone Association. $2,500. Incorporators: W. H. Miller, Almon A. Buffum and others.

BUFFALO, N. Y.—Western New York Water Power Company. To generate electricity. $5,000. Directors: Edward S. A. McLeod, W. E. Frampton and others.

PLEASANT HILL, MO.—The Twentieth Century Telephone Company of the United States of America. $10,000. Incorporators: B. T. MacDonald, H. B. Howell and others.

CHICAGO, ILL.—United States Accumulator Company. $5,000. To manufacture electric apparatus, motors, etc. Incorporators: Max Frank, J. P. Martin and others.

BALTIMORE, MD.—The Hughes Telephone Manufacturing Company. $100,000. To construct and deal in telephones. Incorporators: Charles C. Hughes, Edward L. Ward and others.

MILWAUKEE, WIS.—The Independent Consolidated Telephone Company. $500,000. To construct a line connecting Neenah, Menasha and Appleton. Incorporators: A. L. Hutchinson, Harry S. Cadfield and others.

CANASTOTA, N. Y.—The Canastota & Morrisville Railway Company. $200,000. To construct an electric street surface road 15 miles long between Canastota and Morrisville. Directors: John Reidy, John A. Johnson and others.

KITTERY, ME.—Standard Light Company. $500,000. To carry on a business of manufacturing, selling and dealing in apparatus of various kinds for lighting, heating and other purposes. Mr. Forest A. Ray, of Boston, Mass., is the president.

RICHMOND, VA.—The Richmond-Washington Company. $3,000,000. To construct or acquire railroads, telegraph and telephone lines, and transportation lines by water. Incorporators: Samuel Rea, Bryn Mawr, Pa.; William B. Scofield, Camden, N. J., and others.

TELEPHONE AND TELEGRAPH

The city of Marshfield, Wis., will soon have long-distance telephone connections.

The extension of the Kanona & Towlesville, N. Y., telephone line to Howard, is being agitated.

The work of rebuilding the local system in De Pere, Wis., has been begun by the Wisconsin Telephone Company.

It is reported that the People's Telephone Company, of Detroit, Mich., will absorb the Oakland County Telephone Company.

A model telephone exchange will be installed by the Twin City Telephone Company in the state fair grounds at St. Paul, Minn.

In Los Angeles, Cal., telephone lines are being extended to connect San Denis, La Verne and Lordsburg with the Pomona exchange.

It is reported that the Chickasaw Telephone Company will extend its line from Ardmore to Rush Springs, Tex., and on to Chickasha.

The Consolidated Telephone Company, of Ohio, has purchased the Ithaca Automatic Telephone Company's plant and franchise, of Ithaca, N. Y.

The Bell Telephone Company has decided to erect a handsome new building for its permanent quarters on Forsyth street in Jacksonville, Fla.

The Home Telephone Company, of Owingsville, Ky., has elected its officials, contracted for poles, etc. The work of construction will soon be entered upon.

The Denton telephone exchange, in Denton, Tex., has been bought by Mr. J. G. Carmichael, of Nocona, for something over $10,000 from Mr. S. W. McClure.

The Green Bay & Lake Michigan Telephone Company has been organized in Iron Mountain, Mich. Ex-Governor Edward Scofield, of Oconto, is the president.

On October 1 the Independent Telephone Exchange, at Greenville, Mich., will pass into the hands of the Citizens' Telephone Company, of Grand Rapids, Mich.

The Elizabeth Telephone Company, of Elizabeth, N. J., has been sold to Mr. Barker Gumere, of Trenton, and Mr. J. L. Hammell, president of the Trenton Trust Company.

At Logansport, Ind., the city council has voted to grant an independent telephone system a 50-year franchise under certain conditions, which are understood to be satisfactory.

The Standard Telephone Company, which has just completed an extension from Newton to Bristol, Pa., will extend its lines into New Jersey by running a line across the Delaware River to Burlington.

The village of Oregon, Wis., is to have a telephone exchange. A company with that purpose in view has been organized and filed articles of association. The capital stock is $5,000. Mr. W. H. Johns is among those interested.

The United Telephone and Telegraph Company is to extend its service between Lebanon, Pa., and Jamestown and Suedburg. This will give a through connection for the service of the company with its lines throughout the Schuylkill Valley.

A number of citizens of Harrison, Me., have formed a stock company to build telephone lines to Norway to connect with the lines of the Eastern Electric Company. The company is to be known as the Bolster Mills Telephone and Telegraph Company.

News comes that the Home Telephone Company, of Jamestown, N. Y., will soon begin the construction of an exchange of 1,500 telephones. It is in the market for the entire equipment. The work includes several miles of underground construction.

The lower house of the council of Kansas City, Mo., has passed an ordinance giving to Mr. John Enoch a franchise to build conduits and operate a telephone system there. Mr. Enoch represents the Kinloch interests of St. Louis. The franchise is to run 30 years.

The Two Rivers Telephone Company, of Two Rivers, Wis., has let a contract for the construction of an entirely new system to meet the increased demands for better telephone service in that city. The new system will enable its patrons to have access to the long-distance telephone.

An agreement has been made between the Cass Lake Water, Light and Power Company, of Cass Lake, Minn., which owns a telephone franchise in Cass Lake, and the Iron Range Electric Telephone Company to put in a telephone exchange and connect it with the long-distance lines..

Work has been begun on the rebuilding of the long-distance line in Topeka, Kan., which was formerly run by Mr. P. F. Pankey, of that city, but which is now owned by the new Independent Telephone Company, recently organized at Manhattan. New poles are being put in on the line and the work is progressing rapidly.

The work of putting the cables through the conduits of the Elmira Telephone Company, of Elmira, N. Y., has been begun and is proceeding very rapidly and successfully. The large underground cables contain 200 pairs of copper wires sufficient to supply 200 telephones with single metallic wire service, which is one of the principal features of the system of the new company.

The capital stock of the Rensselaer Telephone and Telegraph Company, in Troy, N. Y., has been increased from $150,000 to $300,000. A contract has been entered into with the Eastern Electrical Construction Company, of Philadelphia, Pa., for the installation of a telegraph and telephone plant which includes a conduit system independent of that which is being put in by the Hudson River Telephone and Telegraph Company.

The majority of the stock of the Boyds Telephone Company, of Boyds, Md., which was owned and held by Mr. Littleton E. Price and Mr. Rowland Barnes, of Mount Airy, has been sold to Mr. Samuel L. Jones and others, who are now owners of stock in other telephone companies in that vicinity. The Boyds Telephone Company will be organized, and it has been decided by the new owners that the capital stock will be increased and the present lines rebuilt.

More franchises are being sought by the Home Telephone Company, of Niagara Falls. They are now paying particular attention to the village of Niagara Falls, South Ontario. At a meeting of the village council a franchise similar to the one granted by the town of Niagara Falls was asked for. A by-law granting such a franchise was submitted, and after being read once was laid over. It is stated that there is no doubt that the franchise will soon be granted.

The Cumberland Telephone Company, of Knoxville, Tenn., has purchased the exchange at Williamsburg, Ky., and 44 miles of toll lines leading therefrom. Mr. Nixon, an official of the Cumberland company, states that this will give the company an extension of service from Jellico to London, Ky., with the Williamsburg exchange the main point on the line. From London the company intends to build to Richmond, Ky., where it will connect with its lines to Lexington, Ky., and Louisville, Tenn.

INDUSTRIAL ITEMS

THE MANHATTAN ELECTRIC SUPPLY COMPANY, of New York, is shipping quantities of its specialties to Mr. E. E. Porter, Shanghai, China.

W. S. HILL ELECTRIC COMPANY, New Bedford, Mass., is planning an early addition to its factory which will nearly double its output of switches and electrical appurtenances.

THE J. G. BRILL COMPANY, of Philadelphia, is about to ship 32 pairs of wheels on axles for the Barcelona Electric Traction system; also car material to Bilbao, Spain, and Neuhausen, Germany.

ROSSITER, MacGOVERN & COMPANY, of New York, N. Y., have issued their September bulletin, in which is described the electrical and steam machinery which it has ready for prompt shipment.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., has just closed several large contracts for hotel telephone equipments. It has a special catalogue covering this work which it will send upon application.

THE HARVARD ELECTRIC COMPANY, 222 to 224 South Clinton street, Chicago, Ill., has issued a descriptive circular and illustrated price-list of its line of patent fuses, lightning arresters and electrical specialties.

THE BARKELEW ELECTRIC MANUFACTURING COMPANY, Middletown, Ohio, has facilities for producing all characters of screw machine work, particularly screws, studs, and special shapes in iron, brass, steel or copper.

THE WESTERN ELECTRIC COMPANY has been awarded a contract by the Mansfield England, Corporation, for laying the mains in connection with the local electrical generating system. The value of the contract is about $43,000.

CHARLES H. BESLEY & COMPANY, Chicago, Ill., is reported to have received an order for grinders to be installed in the Manchester plant of the British Westinghouse Electric and Manufacturing Company, Limited, of Manchester, England.

THE DONCASTER CORPORATION, of England, has contracted for rails, to be utilized in the construction of its electric traction system, with Mr. E. L. Gielgord, who represents the interests of a Belgium concern by which the rails will be manufactured.

THE E. W. BLISS COMPANY, of New York, N. Y., is issuing a very neat pamphlet describing its friction-roll forging drops, open-gap drop hammers, automatic drop hammers, four-poppet drop presses, etc., which should be of great interest to all those who contemplate installing any of these machines.

THE ELECTRICAL ENGINEERING COMPANY, Minneapolis, Minn., one of the largest electrical supply houses of that section of the country, reports through its secretary and treasurer, Mr. George W. Heyford, a decided increase for general electrical supplies throughout the Northwest with the opening of the fall season.

BARTZ, EVONS & WYGANT, of Hornellsville, N. Y., are manufacturing a ball-bearing, direct-current motor, which is adapted to the driving of looms, printing-presses, elevators, air pumps, box machinery, meat choppers, water pumps, shoe machinery and feed cutters. They will be glad to quote prices to those interested.

THE COOPER UNION for the advancement of science and art, of New York, N. Y., is distributing a prospectus of the free classes in civil, mechanical and electrical

engineering and chemistry started last year. This announcement should be of great interest to many parents who wish to send their sons to some engineering institution.

THE YURGAE SIGNALPHONE MANUFACTURING COMPANY, of Milwaukee, is equipping the lines of the New York Cob Company with signalphones in place of the call boxes which have been in use. Mr. Weller has charge of these improvements. The company is also installing its apparatus with the A. D. T. Company, of New York.

THE ALLIS-CHALMERS COMPANY, of Milwaukee, Wis., has shipped a 1,500-horse-power vertical cross-compound engine and other material, which is intended to be installed in the central generating station of the Sydney City & Suburban Tramways, Sydney, New South Wales. A similar machine will be forwarded to Australia in December.

THE ST. LOUIS CAR COMPANY, of St. Louis, Mo., is about to commence shipment on a contract for 250 cars which it has recently secured from one of the principal electric traction systems in Buenos Aires, South America. The company is also about to begin the shipment of some 40 cars for use on the Lisbon, Portugal, Electric Traction system.

THE BROWNING MANUFACTURING COMPANY, of Milwaukee, Wis., manufacturer of the well-known Browning motors and dynamos, reports that its new factory is working 22 hours out of each 24. Browning motors are now fitted to linotype machines, ventilators and blowers, bottle-labeling machines and pumps, as well as being used for ordinary purposes.

THE MILWAUKEE ELECTRIC COMPANY has found its present factory at 294-96 Reed street too small for its large and growing business and will build a new plant, with all the most modern appliances for the manufacture of its standard line of dynamos and motors, at West Allis, the new and promising suburb of Milwaukee. The new factory will employ 500 men, and will be thoroughly equipped.

MR. GEORGE H. DANIELS, general passenger agent of the New York Central & Hudson River Railroad Company, is now issuing number 34 of the Four-Track Series. It is entitled "To Ottawa *via* the Rideau Lakes and River." It is printed in colors and has an accurate and beautiful map of this pleasure-ground. Those seeking new fields for enjoyment will find it extremely interesting.

THE KNEELAND REFLECTOR COMPANY, Boston, Mass., has removed to new and larger quarters at 104 Merrimac street. This company is prepared to furnish fall buyers with reflectors of various sizes, in silver bronze, green bronze and green enamel tops, also Welsbach reflectors. The company carries in stock, also, one-half shades, tin or aluminum, and electric shade holders and mica tops or dust protectors.

THE RELIANCE ELECTRIC COMPANY, Mr. Thomas Croil, president, and Mr. H. B. Dewey, secretary and manager, has established a plant at 206-222 South Water street, Milwaukee, Wis., for the manufacture of motors and dynamos ranging from 10 to 150 kilowatts. The company proposes to use the best of material and the most skillful machinists in the manufacture of its apparatus which will be designed by engineers of experience and ability.

THE CONTRACT for the electrical equipment of the Great Northern & City Underground Railway, of London, England, has been awarded to the British Thomson-Houston Company, Limited, which concern is controlled by the General Electric Company, of the United States. The contract calls for sufficient apparatus for the operation of a three-minute service. Each train is to consist of seven cars. The two end cars and the centre car of the train are to be equipped with motors.

THE A. ANDUJAR COMPANY, 140 Front street, New York, writes to the ELECTRICAL REVIEW that its branch house in Barcelona, Spain, advises it that there is a great demand for all kinds of electrical machinery in that country. This house already has several inquiries on hand and desires to secure the address of some reliable manufacturer for electrical apparatus in general. The house at Barcelona would be very glad to receive catalogues from manufacturers disposed to give the exclusive agency for Spain.

THE CHRISTENSEN MANUFACTURING COMPANY, of Milwaukee, is preparing to make additions to the new factory into which it lately moved. A 30-foot extension will be made to the main building, a 500-horse-power engine will be added to the power-house, and ground will soon be broken for a new office building. This enterprising company has its own brass, iron and steel foundries on the grounds, and, to use a rural expression, "lives at home" while it provides for others in all parts of the country.

THE CENTRAL ELECTRIC COMPANY, of Chicago, has published a new discount sheet on its general catalogue dated September 1, which has been distributed to the general trade. Any one having a Central Electric Company general catalogue who has not received a discount sheet, should notify this company, and a copy of the same will be sent them by return mail. This discount sheet not only covers everything listed in its general catalogue, but contains much new material which has been placed on the market since the publication of the general catalogue.

THE STANDARD ELECTRIC TELEPHONE COMPANY, Madison, Wis., in an interview with a representative of this journal through its general manager, Mr. J. J. Nate, states that the summer and early fall have stimulated a greater demand than was anticipated for telephone instruments and telephone equipments. The company has received some encouraging endorsements recently from installations as to the continued successful operation of exchanges, and also as to the satisfaction of several recent installations.

THE NORTHERN ELECTRIC MANUFACTURING COMPANY, Madison, Wis., is about to more than double the size of its plant, and is preparing to build new offices for its executive staff. These new facilities will make this company one of the largest manufacturers of electrical machinery in the West, and the move is indicative of the fact that the "Northern type" of dynamos and generators is appealing strongly to electrical engineers. The location of this company's factory for becoming a great centre is excellent, as it has unusual shipping facilities for reaching the Northwest, West and Southwest.

MR. C. F. FECUANDE, of the city of Mexico. Mexico, wishes to be put in communication with a manufacturer of electric appliances, for the following concessionary proposition, which he can secure, an electric plant, suitable to furnish 100 arc lights, for a city of 17,000 inhabitants, in a tropical region. The state government in which this city is located gives the concession for a period of thirty years, and pays eighteen thousand ($18,000) dollars per annum, Mexican currency, for the arc lights. It is stated that an equal amount of business can be secured from the citizens of the city for small lights.

THE JAPANESE HOUSE of Takata & Company, which has offices in New York, has recently placed contracts for a large plant which will be installed in the Shiramine Dockyard, Japan. The contracts include two 150-kilowatt direct-current enginetype generators, which are to be direct-connected to the engine. The Westinghouse Electric and Manufacturing Company and the Westinghouse Machine Company, of Pittsburgh, Pa., will supply the machinery. There will be also a Westinghouse switchboard and a 50-horse-power slow-speed multipolar shunt-wound motor, together with the usual accessories.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, is introducing a new "S. L." arc lamp hanger-board with absolute cutout, for series direct or series alternating arc lamps, for use both indoors and outside. The company states that this hanger-board is by far the strongest and practically the best hanger-board it has ever seen, and its success with it has been more than satisfactory. The body of it is made of extra heavy, solid porcelain, with a very handsome black enameled hood. All the exposed parts have a highly glazed surface, and there is no fibre or mica on it to give out. It has a closed top, and the switch is perfectly air and water-tight. It has a seven-eighth-inch break. A very handsome bulletin illustrating this, which is mailed on application, has been gotten out.

THE DELAWARE, LACKAWANNA & WESTERN RAILROAD is operating several trains in connection with the Pan-American Exposition, which rank among the most elegantly equipped of any in the world. This line runs through a portion of the country which is well described as the "Switzerland of America," and the trip made during these early fall days is an ideal one. Foreigners often have characterized this section as the most beautiful in America. The "Lackawanna Limited," leaving New York at nine o'clock each morning, reaches Buffalo at 8 P. M., giving travelers a daylight ride. This train has every convenience in the way of parlor and dining cars. Other daylight trains make excellent connections for the Pan-American Exposition; also travelers may take the sleeper in the evening, reaching Buffalo in the morning after an easy trip.

THE MASSACHUSETTS CHEMICAL COMPANY, Boston, Mass., manufactures chemical products for electrical use. Among these chemical products is Armalac, an insulating compound for armatures and fields; Enamelac, an insulating paint, particularly adapted for wet battery work, as it dries instantly without foul odor, and is durable; and a line of electric tapes, of which the standard brands, made of cotton sheetings and sticky rubber compound, are these: Maschemco tape, Walpole tape, Norfolk tape and Ajax tape; among the brands made of high-grade rubber stock compounded with pure para and no cotton are these: Maschemo splice and Walpole splicing compound. This company is now operating a factory at Walpole, Mass., which, by the way, has water-power generating facilities for electrical equipments, and is one of the most modern factories in America.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, Pa., has recently closed several contracts for the installation of batteries of chloride accumulators in lighting and railway power-houses. Among these are noted the installation of the St. Paul Gas Light Company, of St. Paul, Minn., which is to consist of 166 elements having a capacity at normal rate of discharge of about 1,300 kilowatt-hours, but capable of a much higher discharge rate for the peak work for which it is principally required. The Laclede Power Company, of St. Louis, Mo., is installing a battery of chloride accumulators, consisting of 336 elements having a discharge rate for one hour of 500 amperes on each side of the three-wire system. The Mineola, Hempstead & Freeport Traction Company has contracted for the installation of a battery consisting of 270 elements of chloride accumulator having a discharge rate of 120 amperes, for regulating the rapid fluctuations on the railway circuit. The containing-jars are of sufficient size to allow of 50 per cent increase in capacity.

List of Electrical Patents Issued Last Week

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED SEPTEMBER 10, 1901.

682,165 Contact device for electric railways; William M. Brown, Johnstown, Pa.—This device is one of the character known as closed conduit or button systems.

682,184 Electric lighting by low-frequency currents; Walter C. Fish, Lynn, Mass.—Mr. Fish's apparatus is a phase splitter, which causes two branches of a circuit carrying a low-frequency, alternating current to be displaced in phase, thereby illuminating two lights, such as arcs placed close together, one after the other very rapidly producing the effect of a continuous light.

682,187 Trolley wire support; Walter Gerard, St. Bernard, Ohio.

682,203 Static machine; Thomas B. Kinraide, Boston, Mass.

682,204 Device for indicating leaks in insulation of electric conductors; Isidor Kitsee, Philadelphia, Pa.—This patent refers to a method of connections, with alarm devices included in circuit with them.

682,215 Bushing for electrical conduits; Mathias Mauer and William J. Billings, New York, N. Y.

682,217 Circuit-breaker; Frank A. Merrick, Johnstown, Pa.

682,219 Electric regulator; Morris Moskowitz, New York, N. Y.

682,300 Electrical power-transmission system; Nathaniel G. Warth, Indianapolis, Ind.

682,324 Electric heater; James P. Erie, New York, N. Y.

682,332 Means for automatically reviving exhausted telephone pulsations; Morris C. Mengis, Sheepshead Bay, N. Y.

682,333 Telephone transmitter; Morris C. Mengis, Brooklyn, N. Y.

682,336 Electric sparker for gas engines; Frank R. McMullin, Chicago, Ill.—Mr. McMullin's spark apparatus is so constructed as to shield effectually the spark making contacts from the flame and sudden shock of the explosion of the cylinder.

682,337 Manufacture of incandescing media for incandescent lighting; Rasmus A. Nielsen, Copenhagen, Denmark.

682,351 Frequency indicator; Cummings C. Chesney and William J. Lloyd, Pittsfield, Mass.—This interesting indicator depends for its operation upon the fact that the current flowing through a condenser, bridged across

(Continued on page 32.)

PATENTED
BURNLEY SOLDERING PASTE.
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(*Continued from page 31.*)

an alternating line, depends upon the frequency as well as upon the voltage supplied. It measures the amount of current flowing through such a condenser when connected under normal conditions, and thus indicates any variation of the frequency.

682,377 Electromagnet; Theodore H. Wurmb and Robert Baumann, St. Louis, Mo.

682 380 Electric belt; Willshire M. Davis, Springfield, Mo.

682 381 Electric traction road; Leon Dion, Boston, Mass.

682,417 Electric battery; William Mills, Elizabeth, N. J.

682,458 Telephone protector; Alfred Deck, Franklin Township, Montgomery County, Ind.

682 475 Primary battery; Samuel W. Maquay, Chertsey, England.

682,520 Electrical transformer; Arthur F. Berry, London, England—This transformer is an ingenious appliance, whereby the core is constructed in blocks or sections, having in one dimension a cross section of the sector of a circle. This is accomplished by using alternate thin and thick laminæ of differing widths.

682,540 Electric switch; Charles E. Gaffney, Pawtucket, and Frank A. Tibbetts, Providence, R. I.

682,554 Regulating device for electric arc lamps; Paul Kassbauer, Vienna, Austria-Hungary.

682,566 Mechanism for removing or replacing switchboard jacks; William S. Paca, Erie, Pa.

U. S. ENGINEER OFFICE,
735 N. Capitol St.,
WASHINGTON, D. C., Sept. 16, 1901.

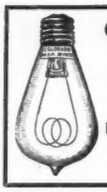
Sealed proposals will be received here until noon, October 16, 1901, and then publicly opened, for furnishing and installing Electric Elevators for New Building for Government Printing Office. Information furnished on application.

JOHN STEPHEN SEWELL,
Capt Engrs.

U. S. ENGINEER OFFICE,
735 N. Capitol St.
Washington, D. C., Aug. 24, 1901.

Sealed proposals will be received here until noon, September 23, 1901, and then publicly opened, for furnishing Electrically Driven Pumps, Cold Drinking-Water Plant, Fire Hose and Racks, and Pipe Covering for New Building for Government Printing Office. Information furnished on application.

JOHN STEPHEN SEWELL,
Capt. Engrs.



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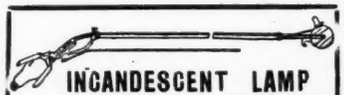

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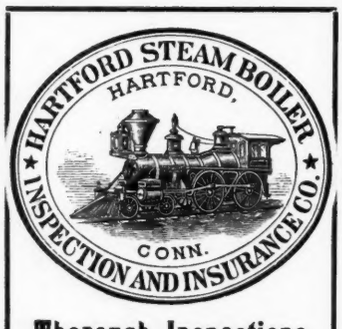

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